OBJECTIVES

Minimize Human and Ecological Risks

-Improve Water Quality

-Stabilize Source Areas

-Prevent Uncontrolled Releases

(b) (5)

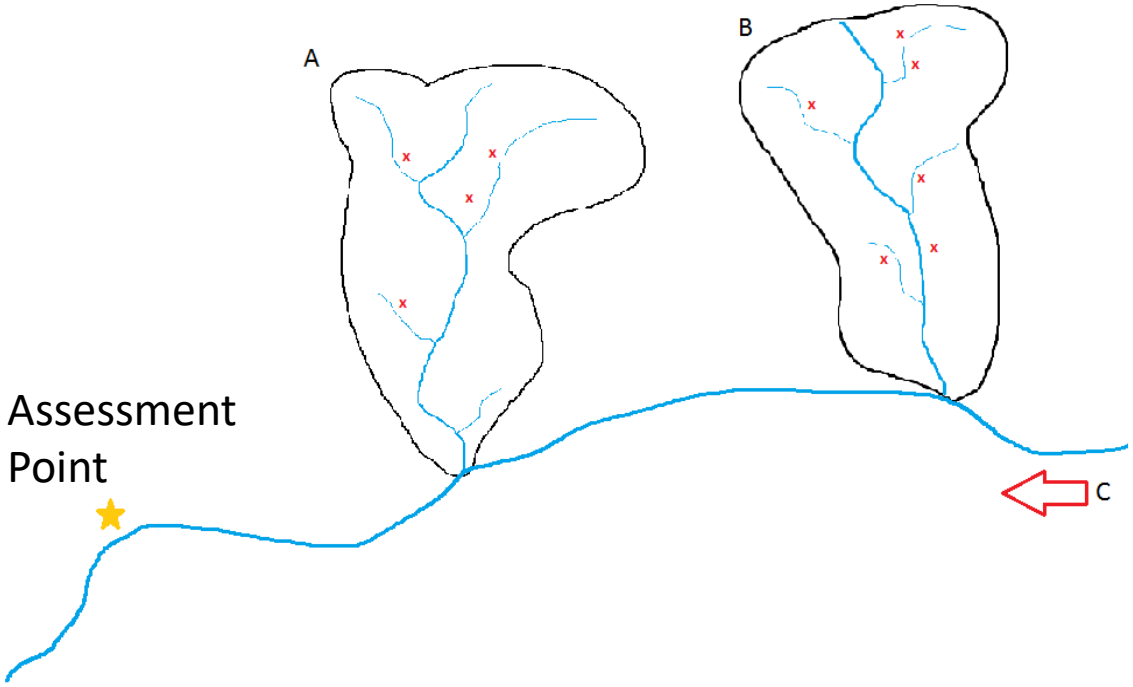
We need to address these questions to:

- Know what we are protecting and where
  - develop measurable goals
- Assess compliance with ARARs
  - determine what is achievable
- Prioritize Actions
  - best bang for the buck

Strategy

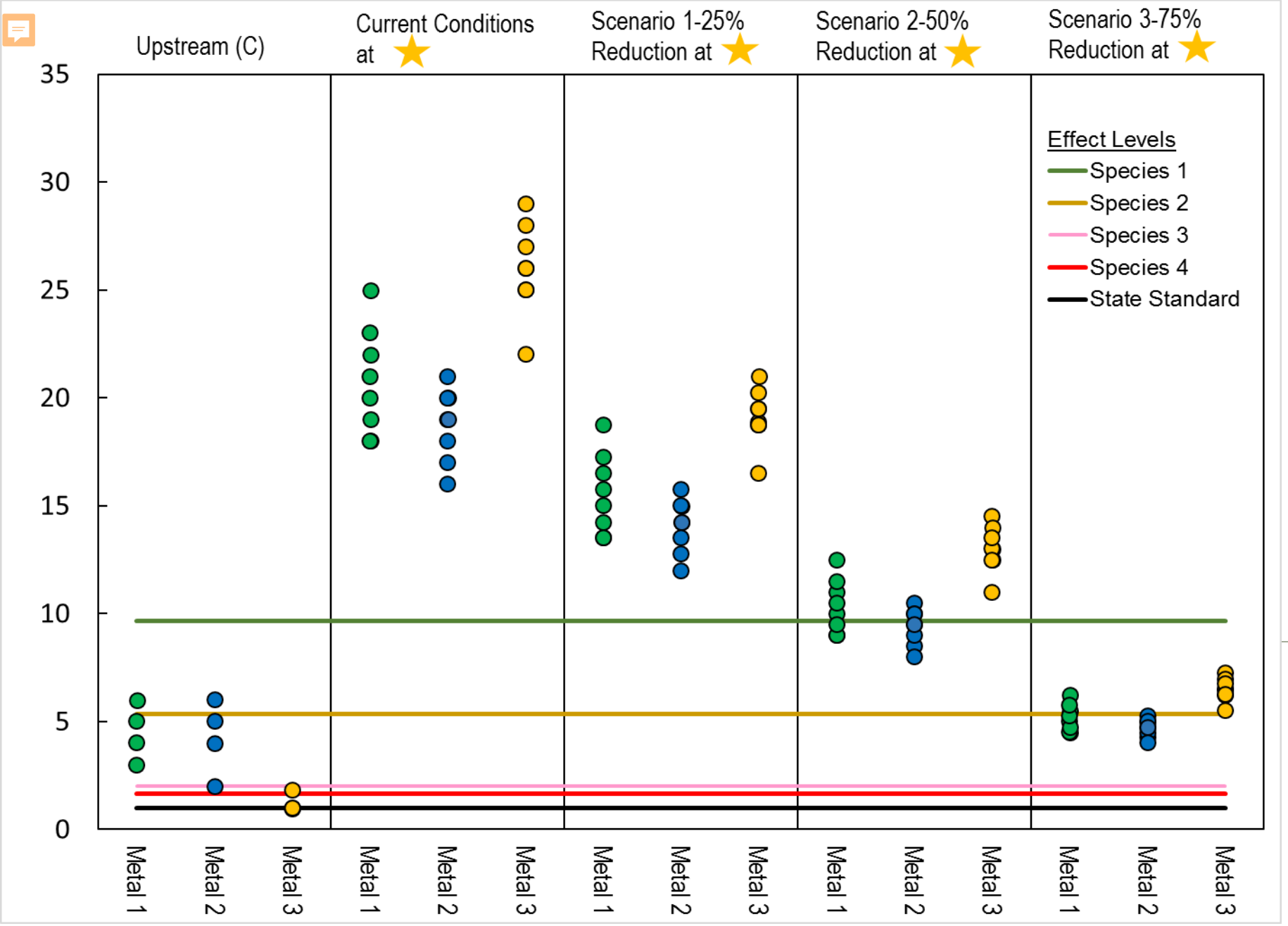
Determine loading contribution from individual mines.

Run remediation scenarios

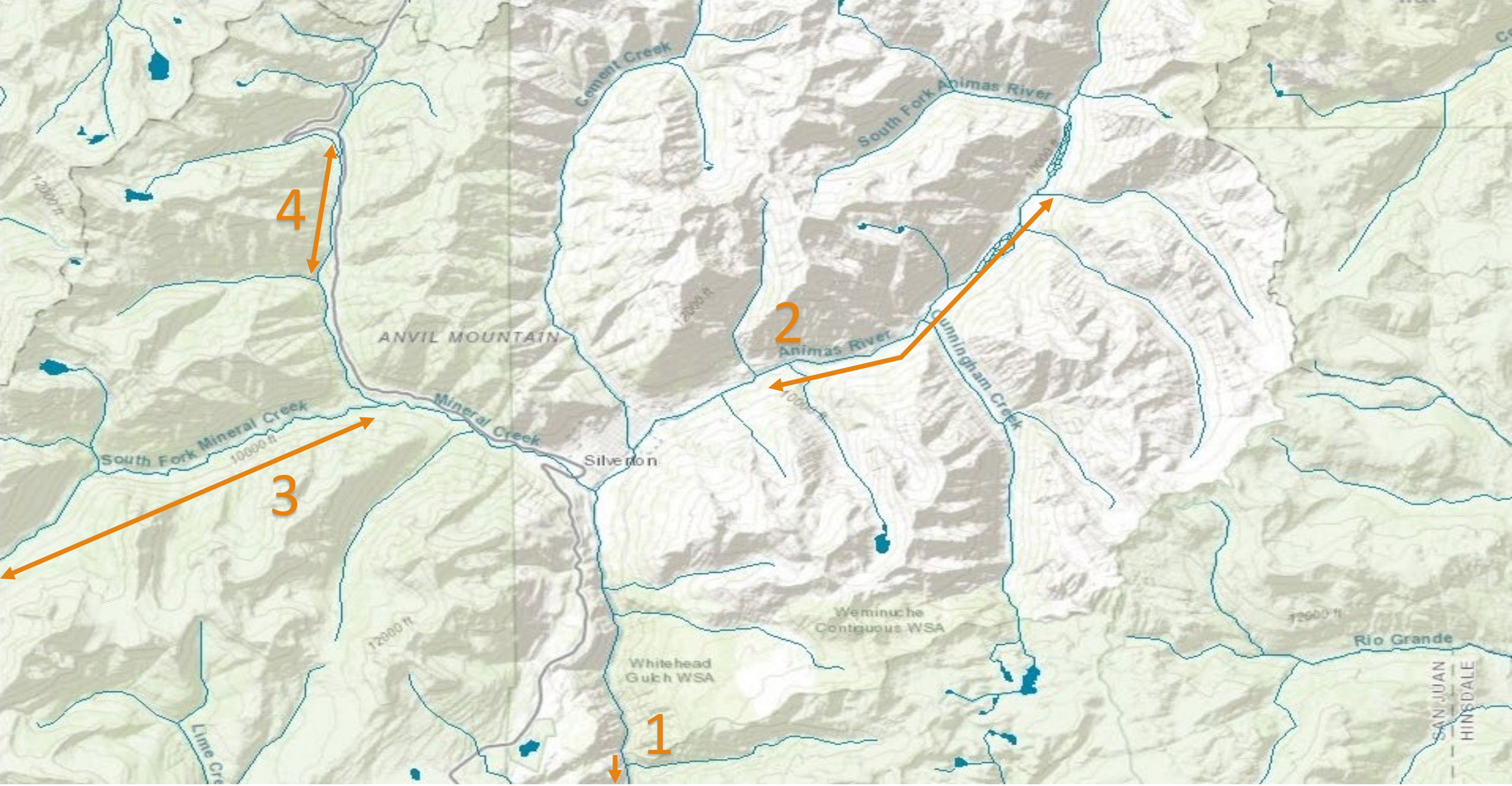


Mine	Reach	% Contribution Within Reach
1	A	10
2	A	50
3	A	5
4	A	35
5	B	5
6	B	30
7	B	30
8	B	5
9	B	5
10	B	25

A+B+C=concentration@



Desired Outcomes


4
2
3
1
ANVIL MOUNTAIN
Cement Creek
South Fork Animas River
Animas River
Cunningham Creek
Mineral Creek
South Fork Mineral Creek
Silverton
Weminuche
Contiguous WSA
Whitehead
Gulch WSA
Rio Grande
SAN JUAN
HINSDALE
12000 ft
10000 ft

Priority 4-Upper Mineral Creek

Goal-Improve Water Quality

- Desired Outcomes
  1. Possible expansion of Mill Creek Fishery
  2. Improve BMI Community
  3. Reduced Loading to Priority 1 (Canyon Reach)

- Source Areas
  1. Koehler (3 lb Zn/day)
  2. Junction (0.15 lb Zn/day)
  3. Silver Ledge (5 lb Zn /day reach load)

Priority 3-South Fork Mineral Creek

Goal-Improve Water Quality

- Desired Outcomes
  1. Enhance Numbers and Diversity of Existing Fishery
  2. Reduced Loading to Priority 1 (Canyon Reach)
  3. Improve BMI and Trout Corridor to Animas*

- Source Areas
  1. Bandora (3.35 lbs Zn/day)
  2. Upstream? (126 lb Al/day & low pH)

Priority 2-Howardsville Area

Goal-Improve Water Quality

- **Desired Outcomes**
  1. Improve Numbers and Spatial Extent of Existing Fishery.
  2. Reduced Loading to Priority 1 (Canyon Reach)

- **Source Areas**
  1. California Gulch (77 lbs Zn /day)
     - Columbus Mine (Adit Load ~0.5 lbs Zn/day , Reach loads 20 lbs Zn /day)
     - Frisco/Bagley (Reach loads ~6 lbs/day)
     - Vermillion?
  2. Mainstem Animas
     - Silver Wing (Reach Load 11 lbs/day)
     - Tom Moore (Reach Load 23.6 lbs/day)
  3. Pride of the West Mill (Reach Load ~10 lbs/day)
  4. Mayflower (45-66 lbs/day)

Priority 1-Canyon Reach

Goal-Meet TVS (except Al?) in Animas Below Elk Creek

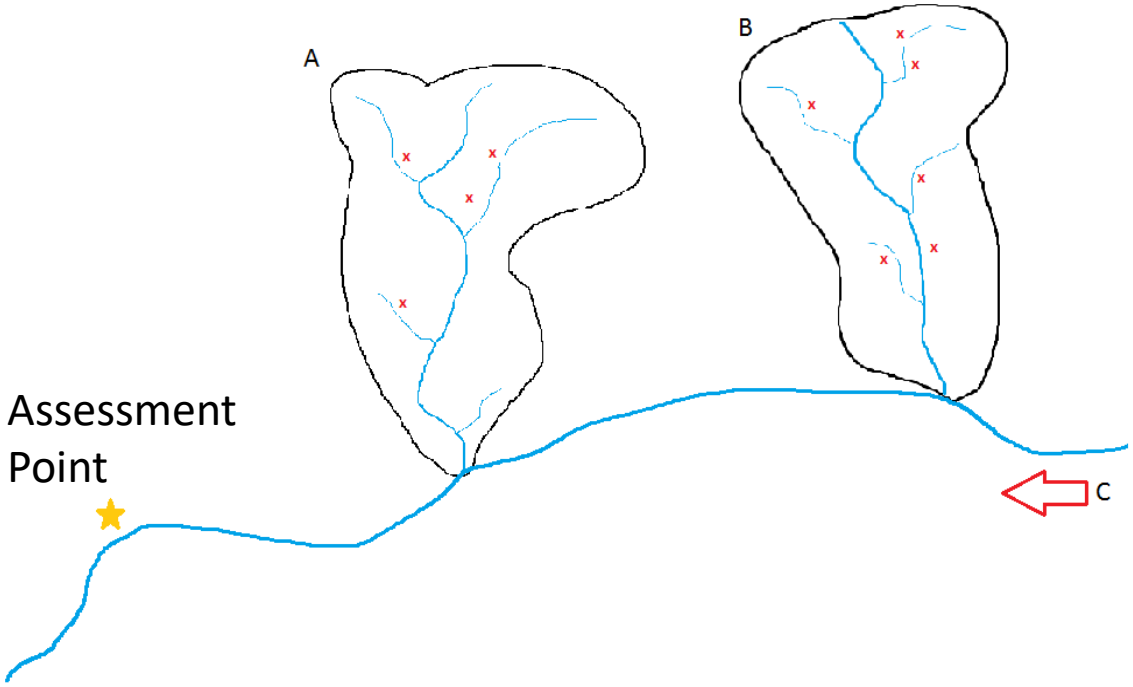
- Desired Outcomes
  1. Meet TVS (Except Al)
  2. Improve Numbers and Diversity of Existing Fisheries.

- Source Areas
  1. All upstream priority source areas
  2. Cement Creek
     - Red and Bonita (65 lbs/day)
     - Mogul (21.4 lbs/day)
     - Natalie Occ. (10.23 lbs/day)
     - Grand Mogul (7.12 lbs/day)
     - Prospect Gulch (3.07 lbs/day)
     - Other

Strategy

Determine loading contribution from individual mines.

Run remediation scenarios



Mine	Reach	% Contribution Within Reach
1	A	10
2	A	50
3	A	5
4	A	35
5	B	5
6	B	30
7	B	30
8	B	5
9	B	5
10	B	25

A+B+C=concentration@

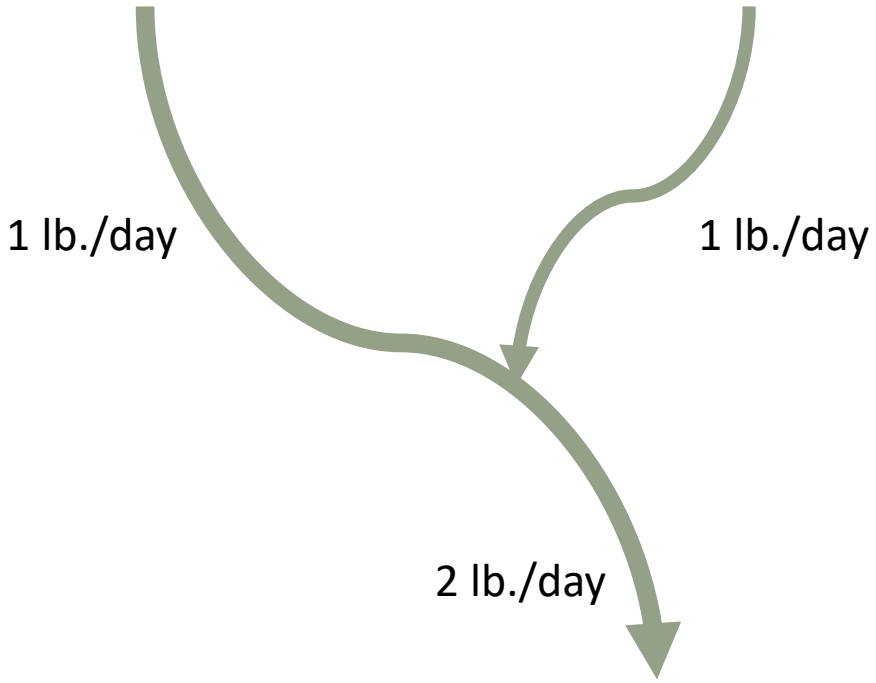
Metals Loads

- Metals are measured in water as a concentration
- The rate at which metals enter surface water depends on the flow and is called a load or loading rate

Concentration x Flow = Load (*in pounds of metal / day*)

- A high concentration of metals with a low flow rate results in a small load and has little impact on surface water
- A moderate concentration of metals with a high flow rate results in a large load and has a significant impact on surface water

Metals Loading Analysis



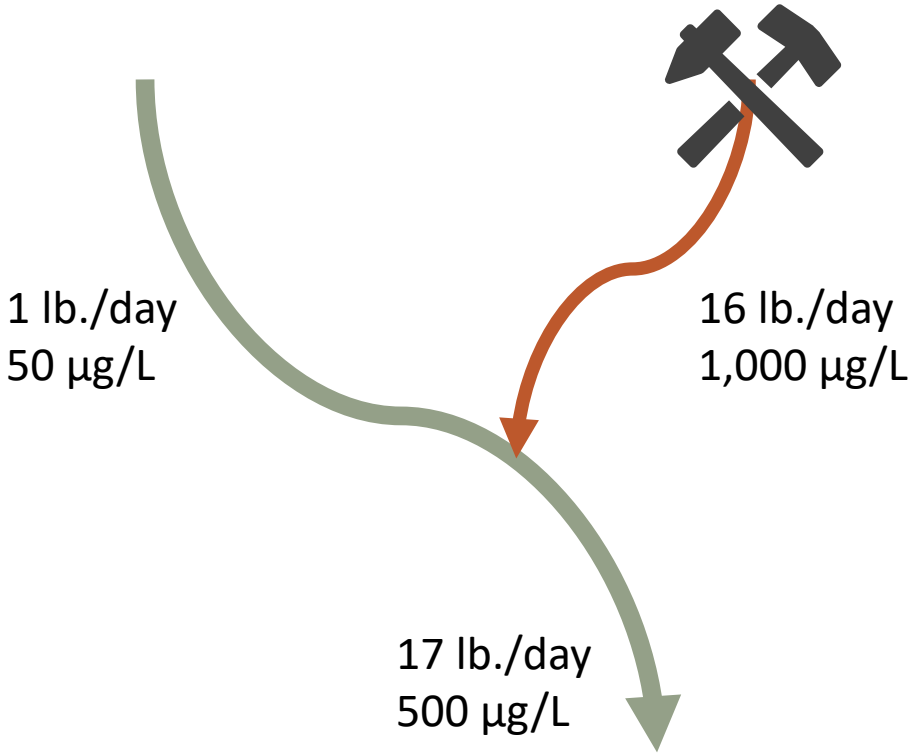
In order to evaluate which sources impact metals concentrations in surface water the most, concentrations need to be converted to loads. These are reported in pounds per day.

The rules of flow analysis also apply to conservative metal loading analysis:

1 + 1 = 2 lb./day

As with flow, this analysis works as long as some inputs and outputs are known. The unknown inputs and outputs can be calculated.

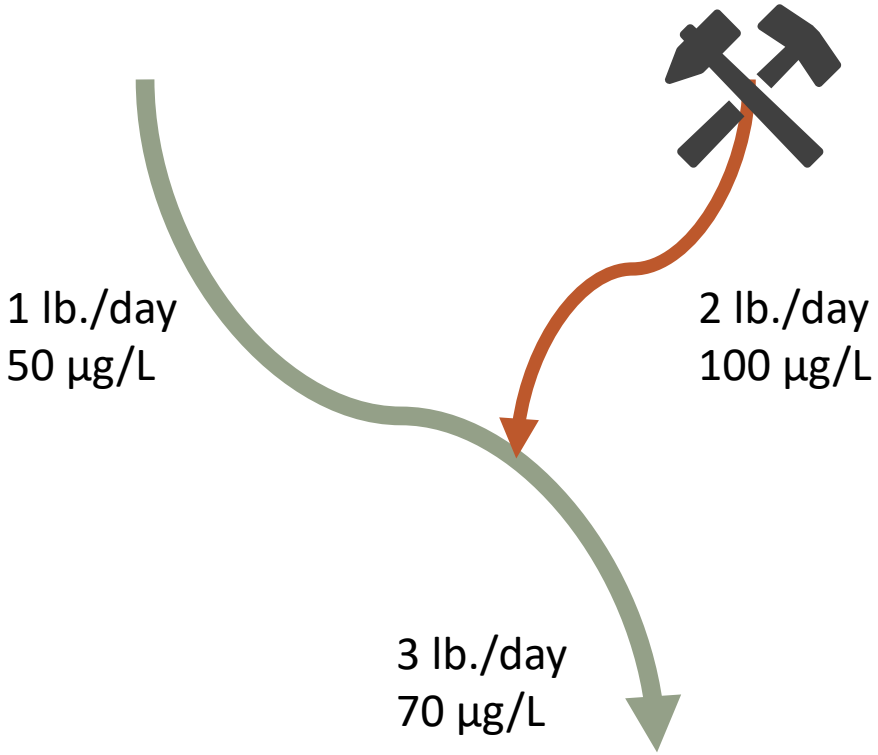
Metals Loading Sources



A mine site may be a significant source of metals loading resulting in high concentrations of metals in surface water.

In order to evaluate the effects of cleaning up a source such as a mine, the basic loading math is used to estimate the new metals load and concentration.

Metals Loading Reduction



Addressing a mine site source by reducing the concentration of metals in the discharging water results in lower concentrations in surface water.

Concentrations cannot be directly subtracted due to the dependence on flow rates. Concentrations are converted to loads, load is subtracted, then the new downstream load is calculated:

90 percent reduction = 2 lb./day
1 + 2 = 3 lb./day

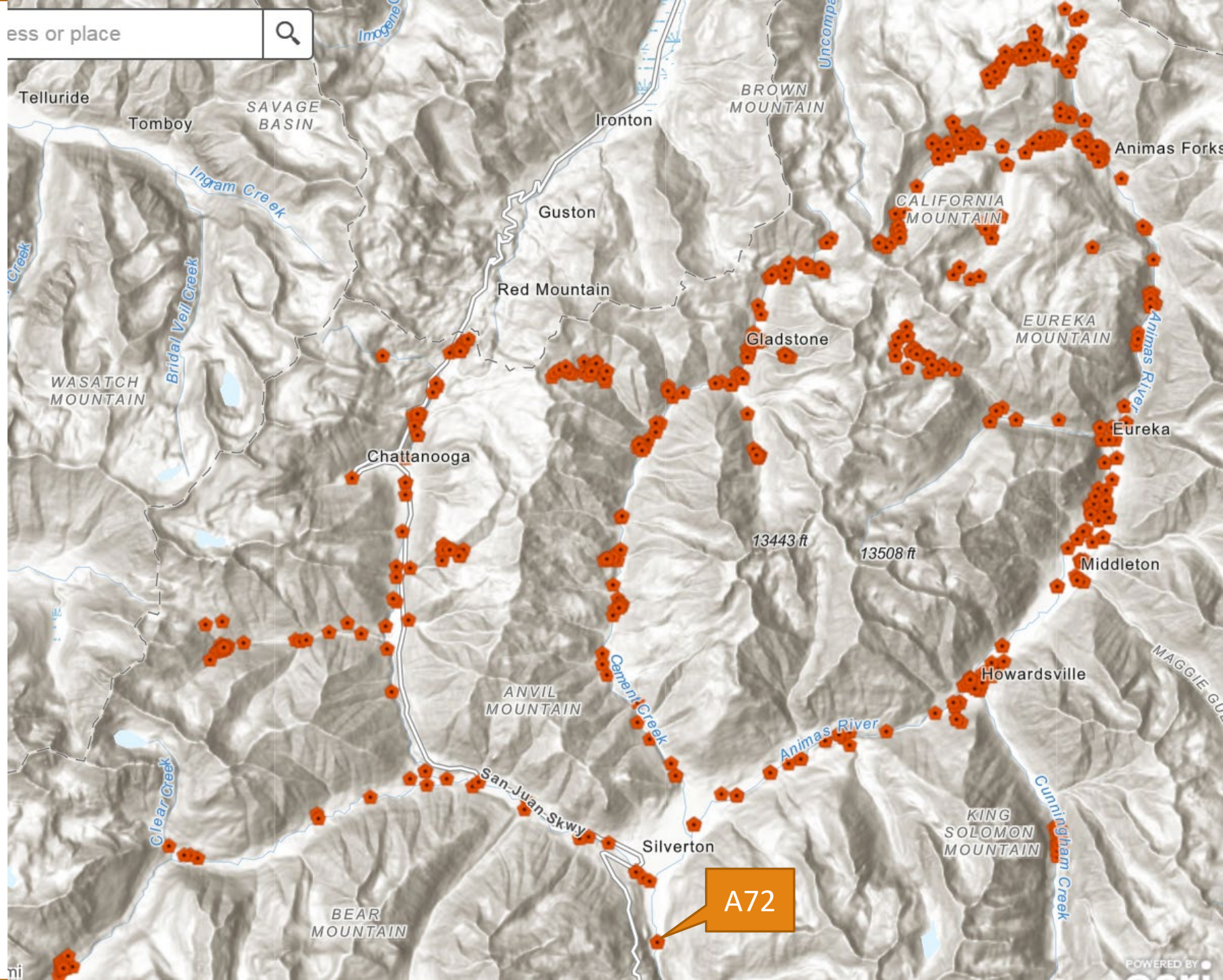
The load is then converted back to a concentration:

3 lb./day = 70 µg/L

Data

EPA has been collecting data at Bonita Peak since 2010

Thorough coverage for site-wide analysis



Major Streams/Rivers

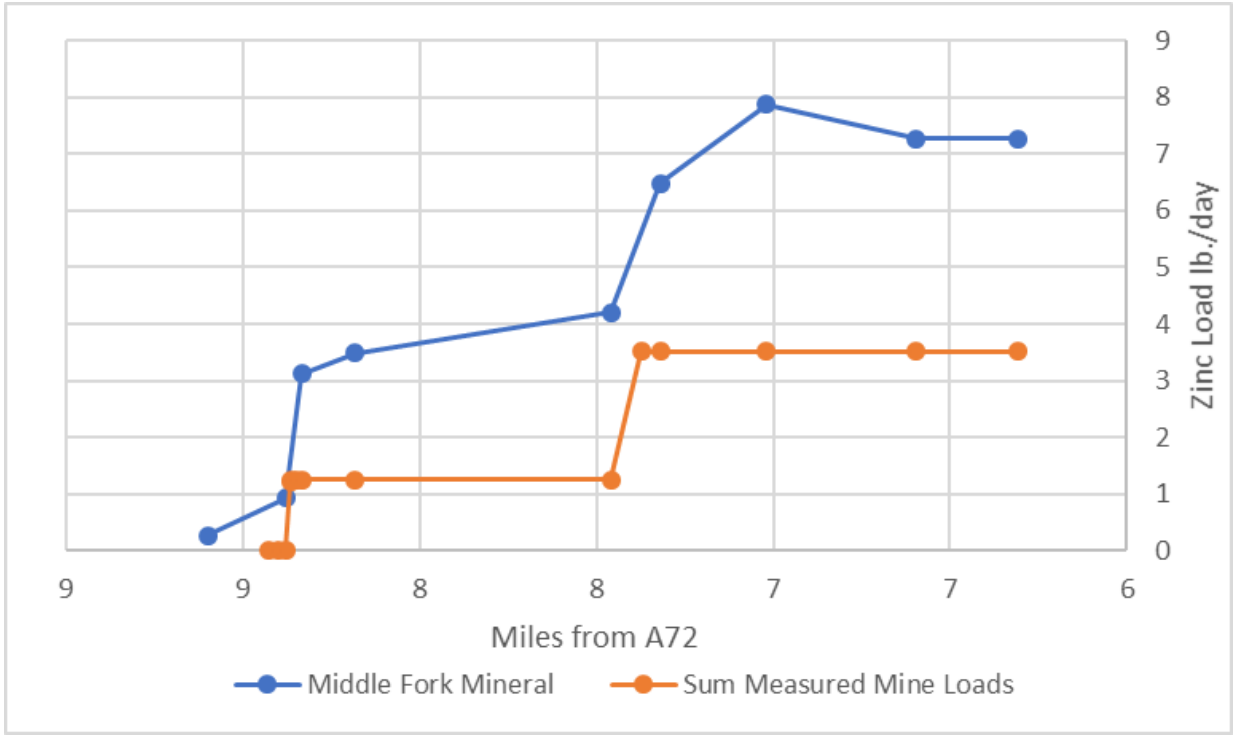
- The major streams and rivers at Bonita Peak are:
  - Animas River
  - Mineral Creek
  - Cement Creek
- Each has tributaries, some are very important source areas
- Analysis of flow data show flows are lowest at headwaters and increase downstream as expected
- Station A72 includes all tributaries and is an important station (Station 0.0)

Initial Loading Comparison

All sources are added from upstream to downstream to obtain a total measured source load

This summation is compared to actual in-stream loads

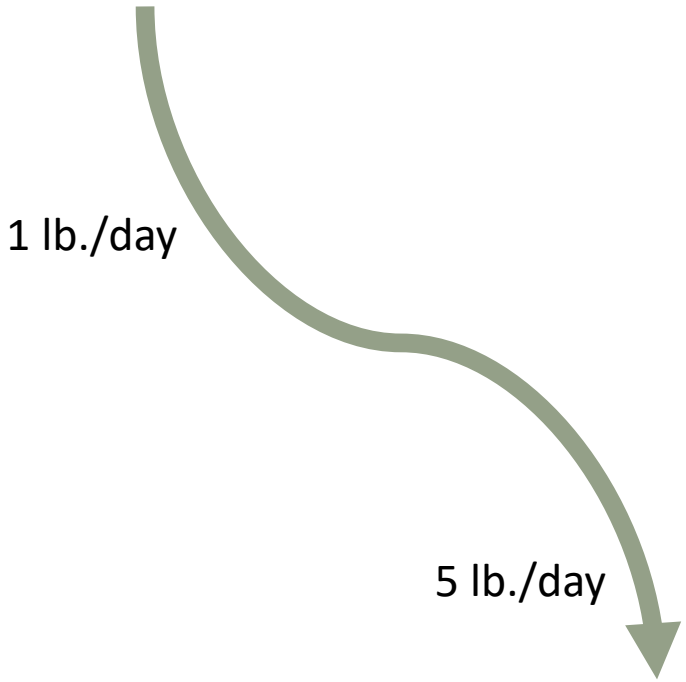
If the lines don't match, there are unmeasured loads



Reach Loads

- If loading increases from upstream to downstream, loading is present
- If summation of measured loads doesn't match in-stream loads, unmeasured loads are present
- Unmeasured loads are calculated as the total load minus the measured loads
- Reach loads can represent a number of different factors happening instream:
  - Natural sources (i.e. background)
  - Unmeasured anthropogenic sources
  - Measurement or data error (e.g. bad flow measurement)
  - Loss of metal to the sediment via precipitation (negative reach load)
  - Changes in hydrology (e.g. losing reach)
- Cadmium, manganese and zinc are expected to have small precipitation losses

Reach Loading Analysis

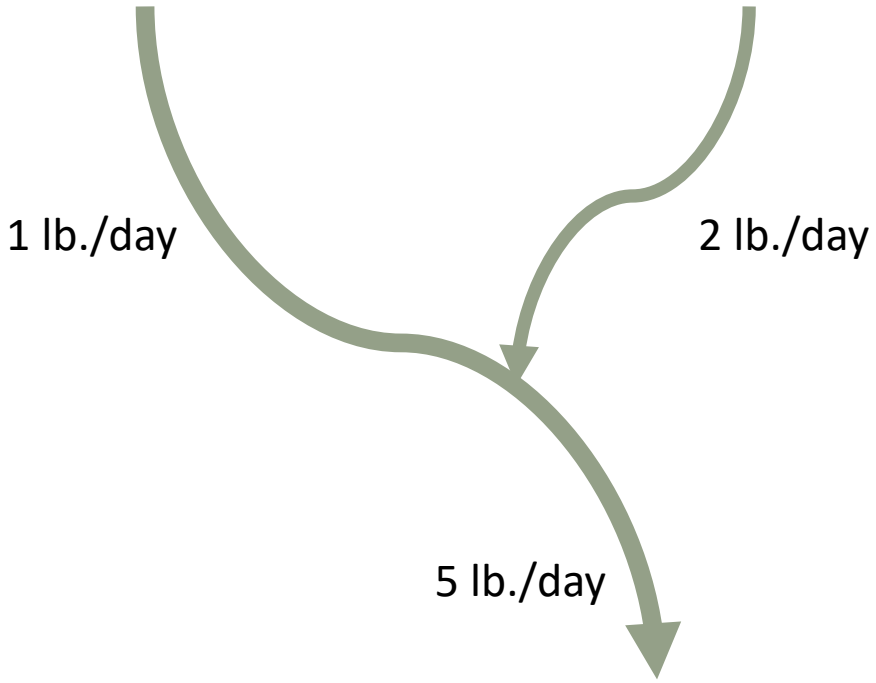


A load increase between upstream and downstream is determined:

5 - 1 = 4 lb./day

This is the reach load

Reach Loading Analysis



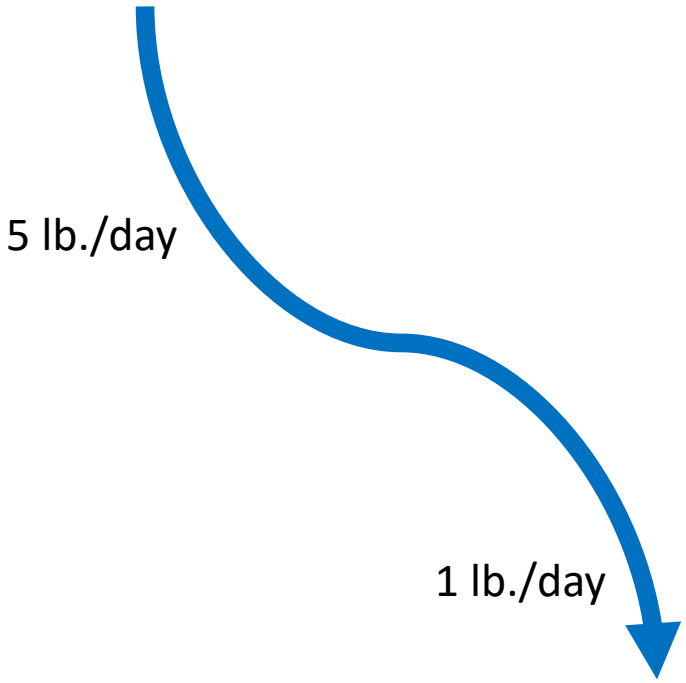
Later, a source is measured to improve the knowledge of the site

Subtract the 2 lb./day measured source load:

4 – 2 = 2 lb./day

Now, 2 lb./day is the unmeasured load in this reach.

Reach Loading Analysis



A load decrease between upstream and downstream is determined:

1 - 5 = -4 lb./day

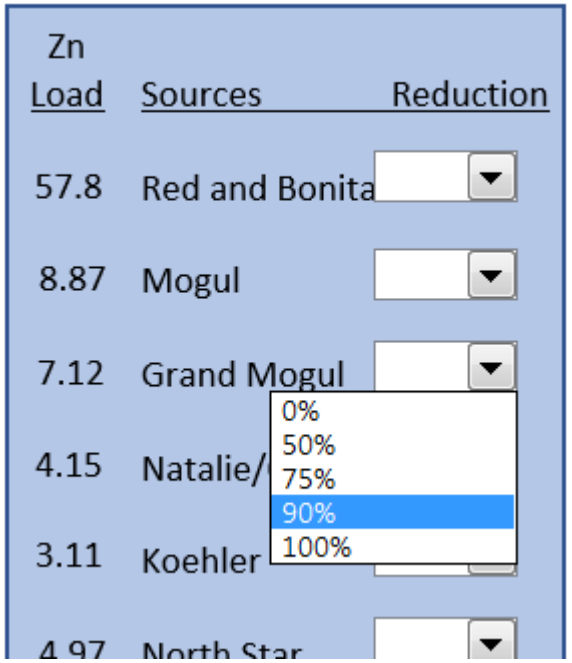
This is an example of a **negative** reach load

Source Cleanup and Resulting Water Quality Improvements

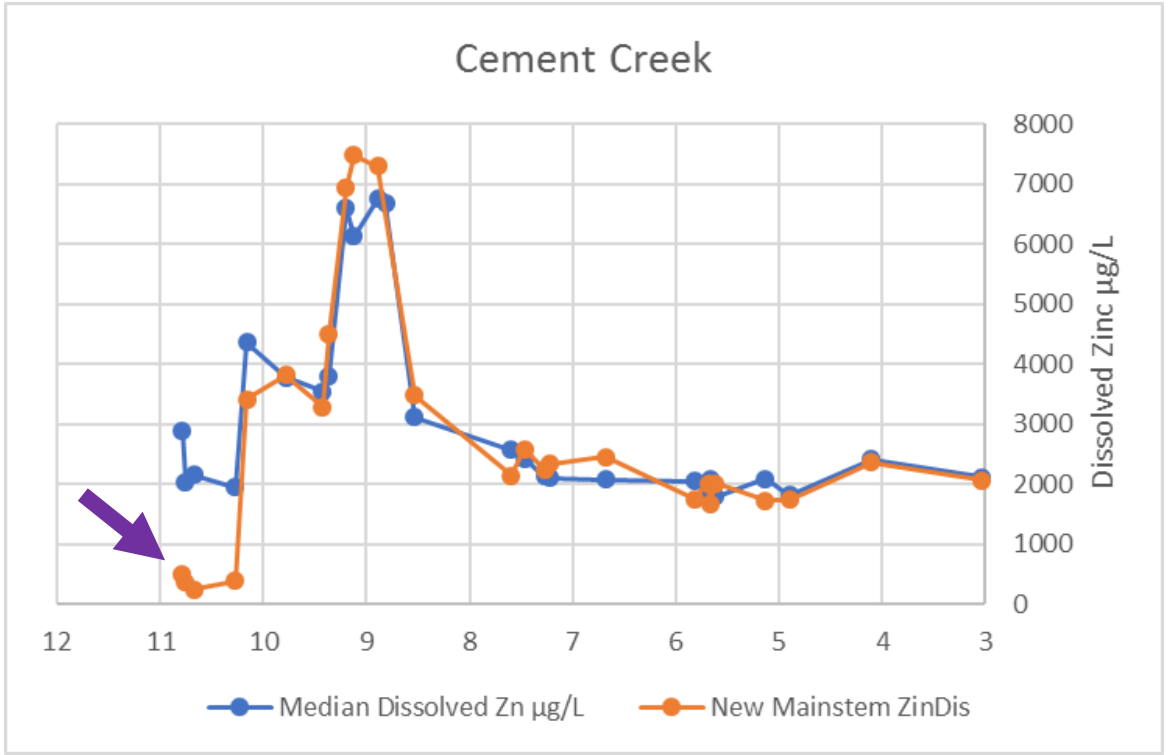
- With all of the measured sources and unmeasured reach loads tabulated, it is now possible to evaluate the results of addressing mine site sources
- Some sources can be greatly reduced such as collection and treatment in a water treatment plant (nearly 100% reduction)
- Other sources are remote or more difficult to obtain reductions (maybe 50%)
- A menu panel has been developed to evaluate the effects of various source load reductions
- Once loading calculations are complete, metal concentrations are back-calculated

Source Reductions

- For each load (measured or unmeasured), select a load reduction



- The reduction will produce a lower concentration in the graph



Current Limitations of the Loading Tool

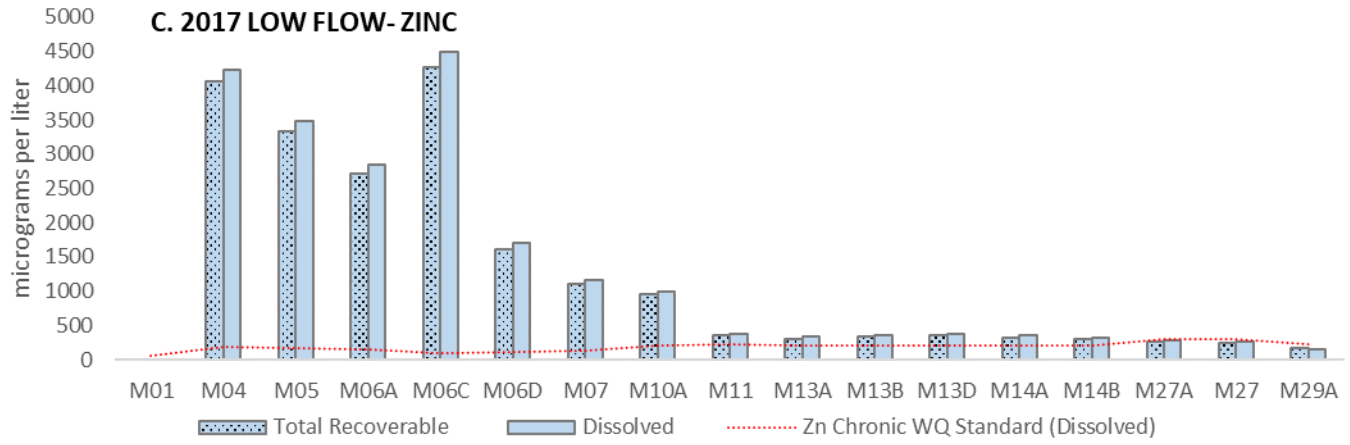
- Uncertainty in the measurements (flow and concentration)
- Variability in the availability of data (some locations are measured only once while others more often)
- Applicable only to generally conservative metals/ions
- Negative reach loads

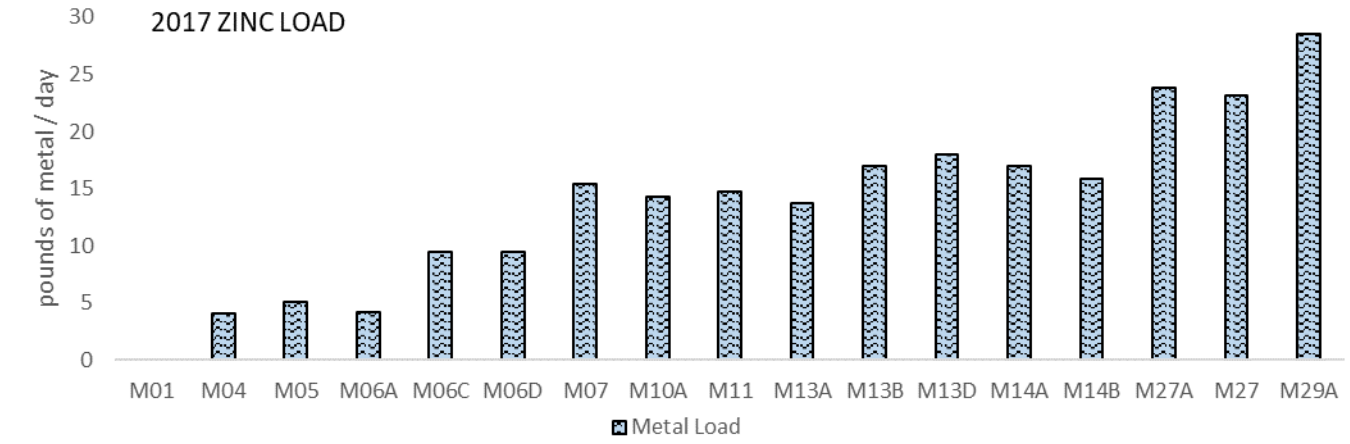
Priority 4-Upper Mineral Creek (Cont.)

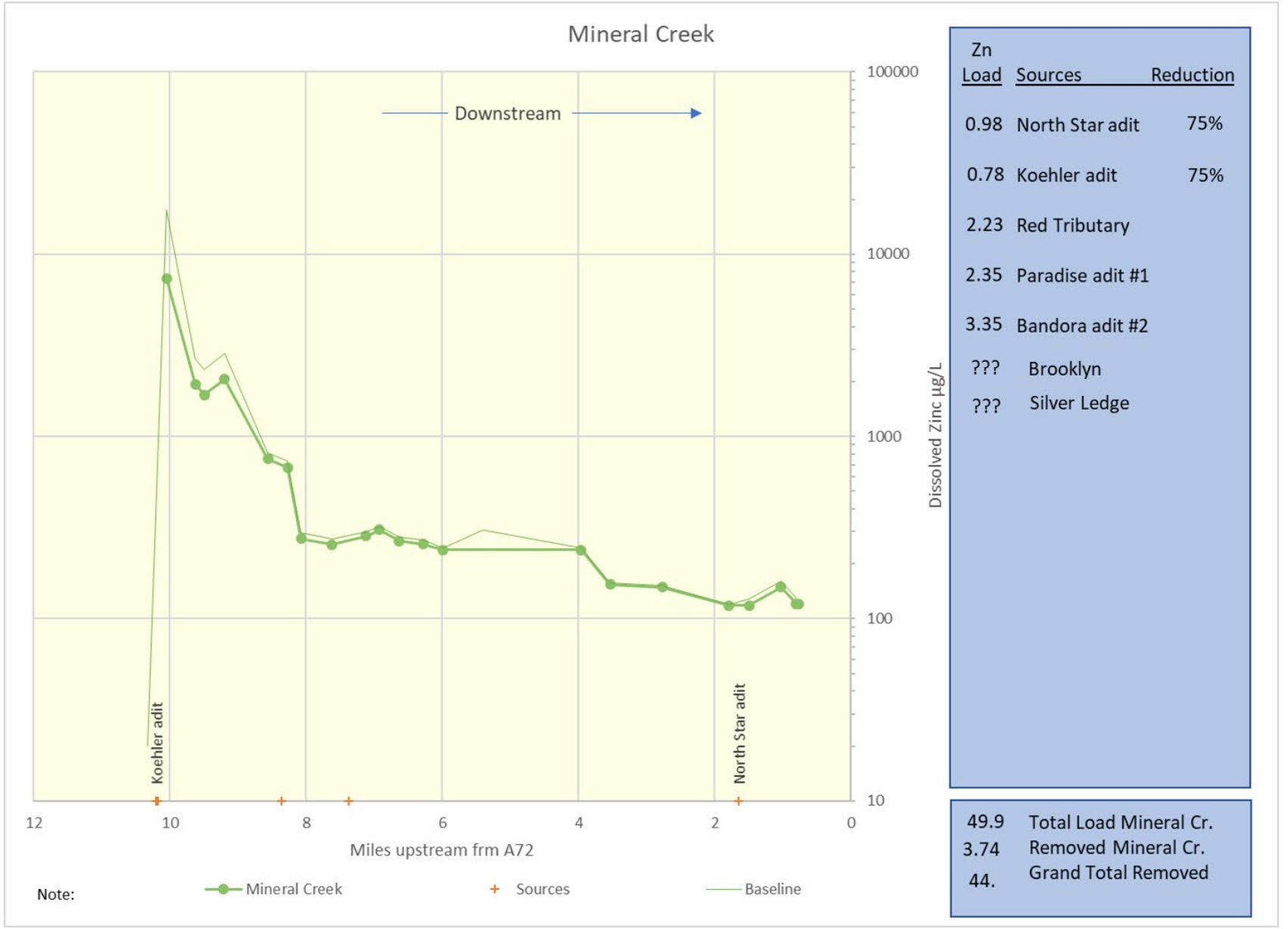
Goal-Improve Water Quality

- Current WQ Standards
  1. Segment 8 Source to Above South Fork: *Agriculture, Recreation E.*
     - No Acute Stds. Maintain Ambient Conditions to Protect Animas.

- Source Areas
  1. Koehler (3 lb Zn/day)
  2. Junction (0.15 lb Zn/day)
  3. Silver Ledge (5 lb Zn /day reach load)

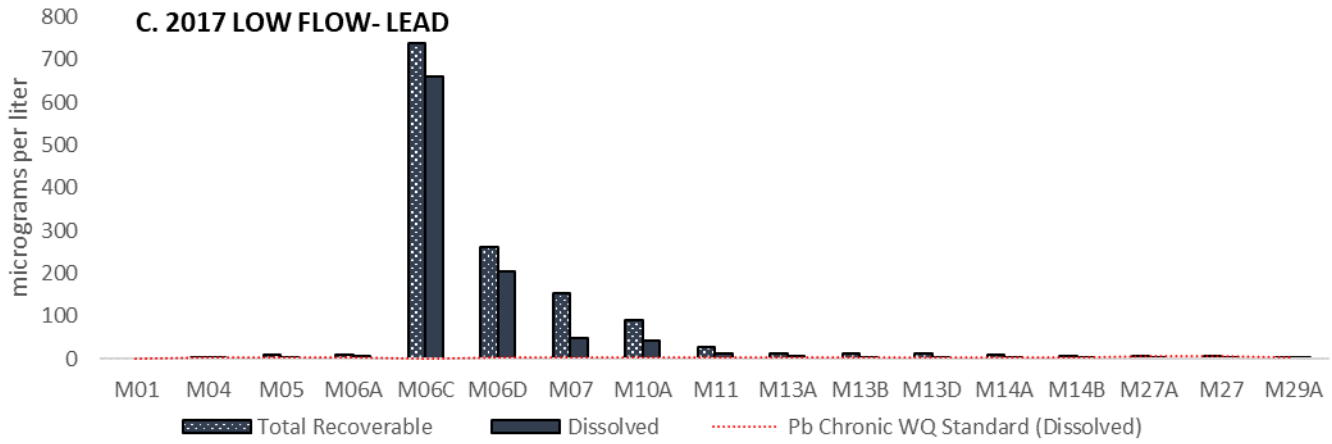

C. 2017 LOW FLOW- ZINC
micrograms per liter
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
M01 M04 M05 M06A M06C M06D M07 M10A M11 M13A M13B M13D M14A M14B M27A M27 M29A
Total Recoverable
Dissolved
Zn Chronic WQ Standard (Dissolved)

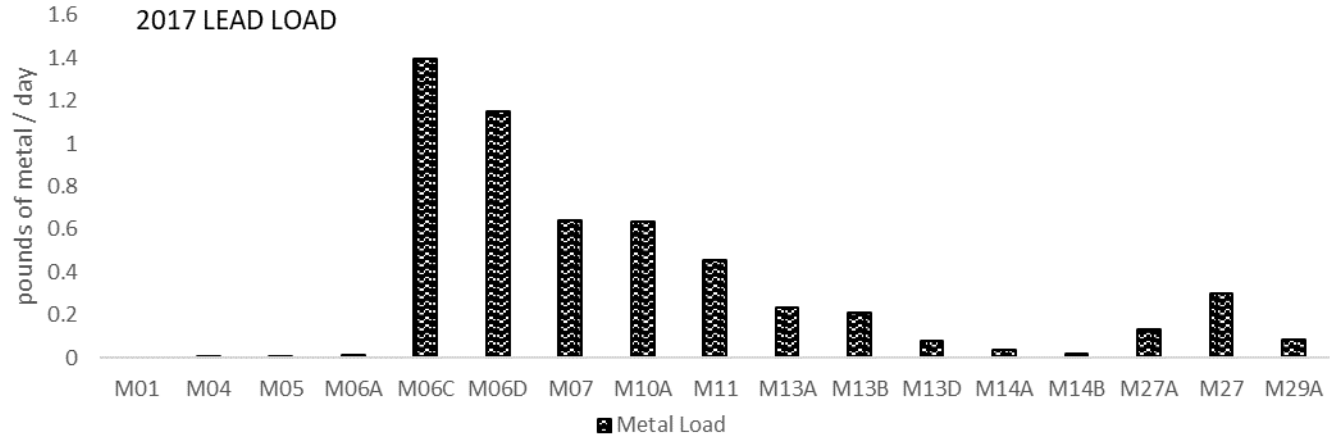

2017 ZINC LOAD
pounds of metal / day
30
25
20
15
10
5
0
M01 M04 M05 M06A M06C M06D M07 M10A M11 M13A M13B M13D M14A M14B M27A M27 M29A
Metal Load



Zn Load	Sources	Reduction
0.98	North Star adit	75%
0.78	Koehler adit	75%
2.23	Red Tributary	
2.35	Paradise adit #1	
3.35	Bandora adit #2	
???	Brooklyn	
???	Silver Ledge	

49.9	Total Load Mineral Cr.
3.74	Removed Mineral Cr.
44.	Grand Total Removed


C. 2017 LOW FLOW- LEAD
micrograms per liter
800
700
600
500
400
300
200
100
0
M01 M04 M05 M06A M06C M06D M07 M10A M11 M13A M13B M13D M14A M14B M27A M27 M29A
Total Recoverable
Dissolved
Pb Chronic WQ Standard (Dissolved)


2017 LEAD LOAD
pounds of metal / day
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
M01 M04 M05 M06A M06C M06D M07 M10A M11 M13A M13B M13D M14A M14B M27A M27 M29A
Metal Load

Priority 4-Upper Mineral Creek (Cont.)

Goal-Improve Water Quality

- Data Gaps
  1. Complicated Area
  2. Silver Ledge Limited Data. (Porphyry Gulch, Big Horn Creek?)
  3. Status of Existing Fishery
     - Is the brook trout fishery in the mainstem resident or coming in from Mill Creek?

- Background Needs
  1. Porphyry Gulch, Big Horn Gulch?
  2. Unnamed tributary near bottom of EU3

Priority 3-South Fork Mineral Creek

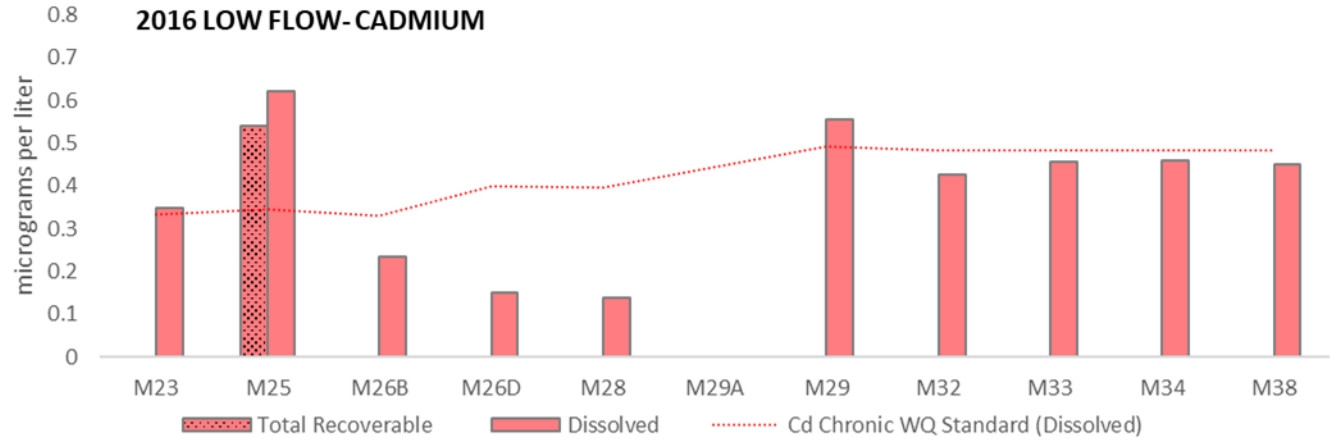
Goal-Improve Water Quality

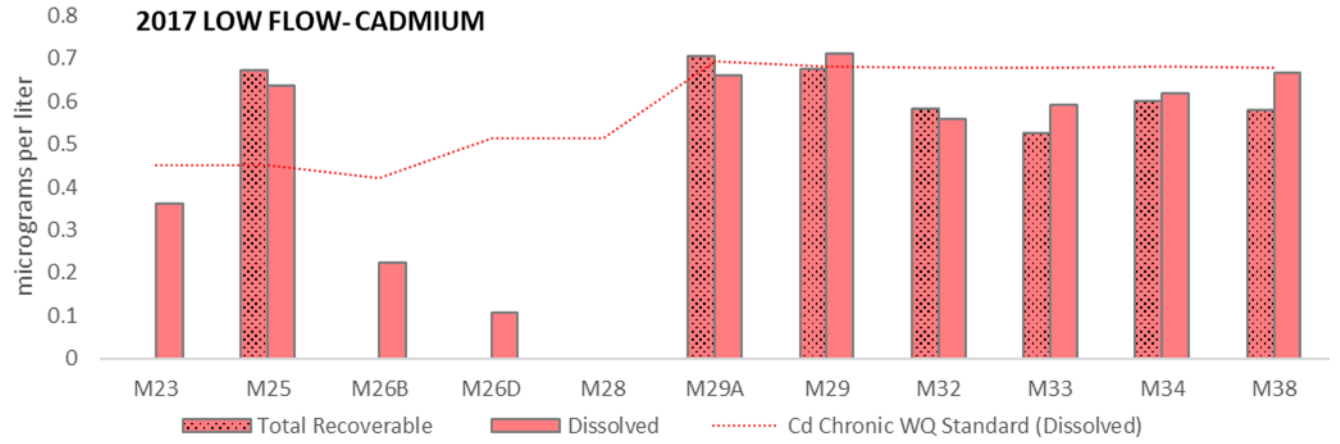
- Risk (EU5~3.7-5.7 miles)
  1. BMI impaired at mouth (MMI: 35 at M28) but not higher up (MMI: 59 at M26A)
  2. BRK present and historically present, RBT stocked, anecdotal evidence of CUTT
  3. Some sediment toxicity (70% survival), no acute SW toxicity
  4. SW Risk Drivers: Al (Low)
  5. Sediment Risk Drivers: Low risk (Cd), Mod. risk (Al),High risk (**pH**, Fe)
  6. Habitat: Physical habitat not evaluated, temperatures may be too cold for CUTT

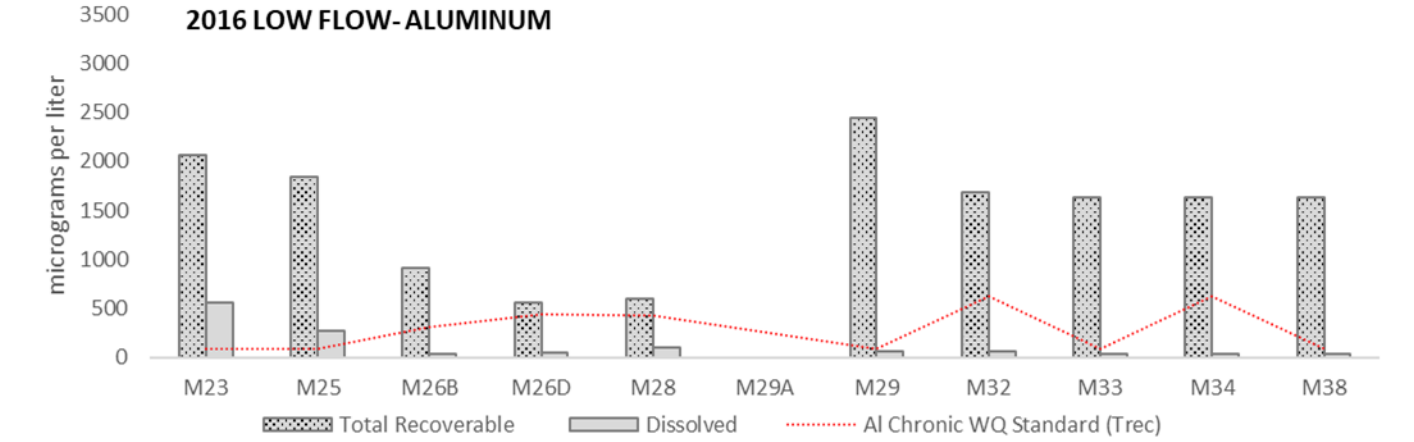
Priority 3-South Fork Mineral Creek

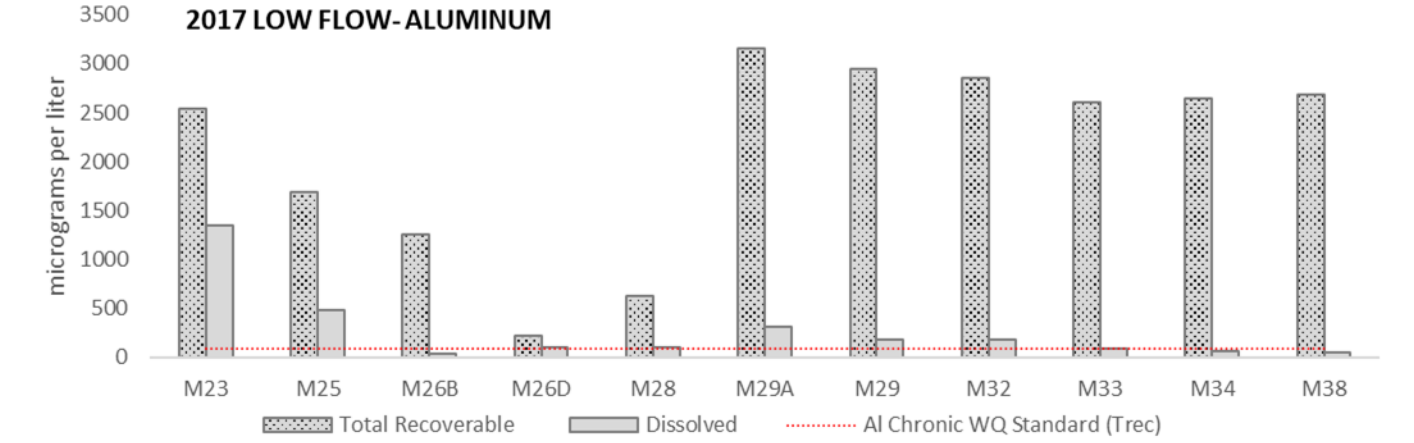
Goal-Improve Water Quality

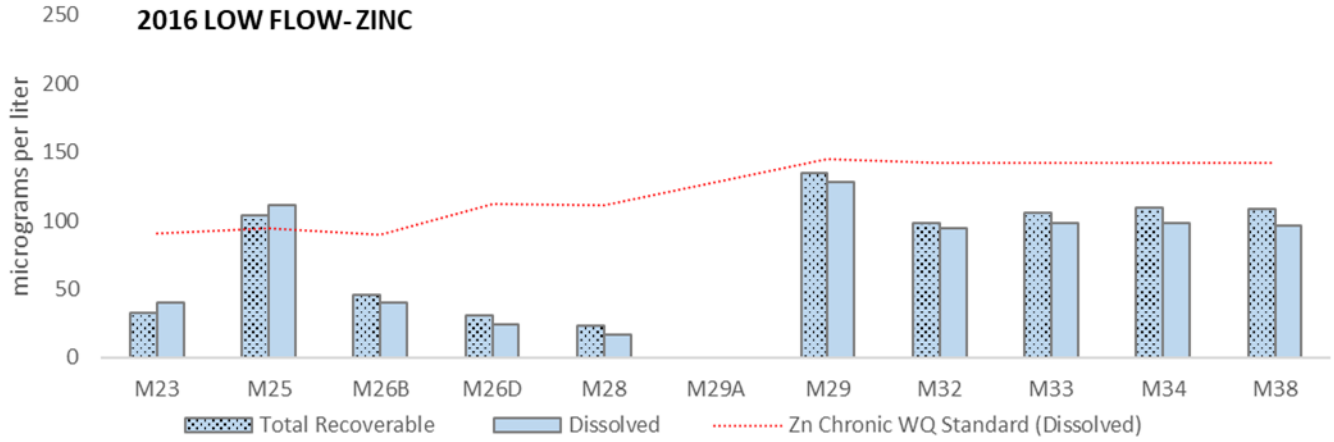
- Current WQ Standards
  1. Segment 6; South Fork Mineral; *Aquatic Life Cold 1*
  2. TVS + SSE for Cd.
  3. Aquatic Life Indicator Goal
     - Macroinvertebrates
- Source Areas
  1. Bandora (3.35 lbs Zn/day)
  2. Upstream? (126 lb Al/day & low pH)

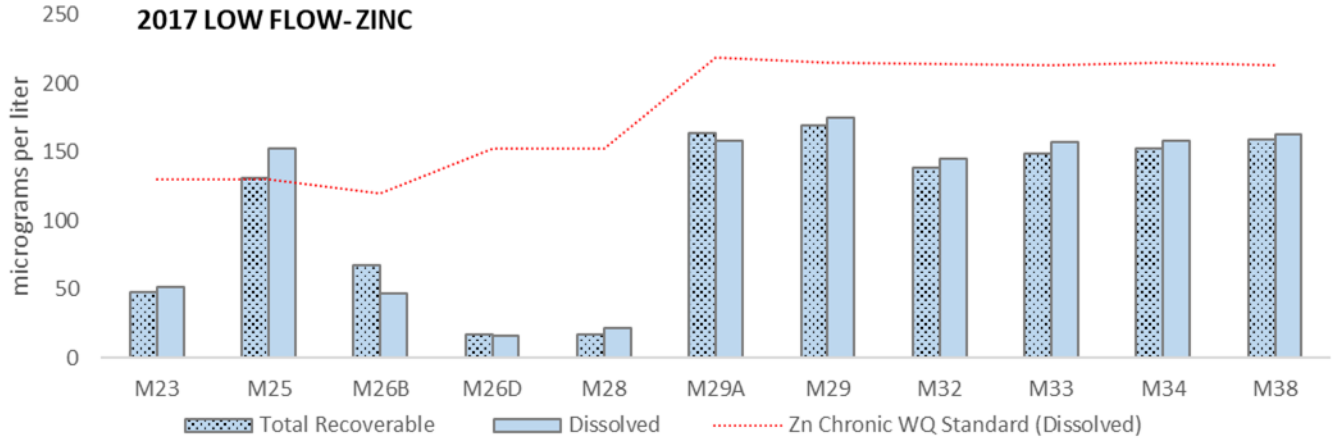

2016 LOW FLOW- CADMIUM
micrograms per liter
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
M23
M25
M26B
M26D
M28
M29A
M29
M32
M33
M34
M38
Total Recoverable
Dissolved
Cd Chronic WQ Standard (Dissolved)

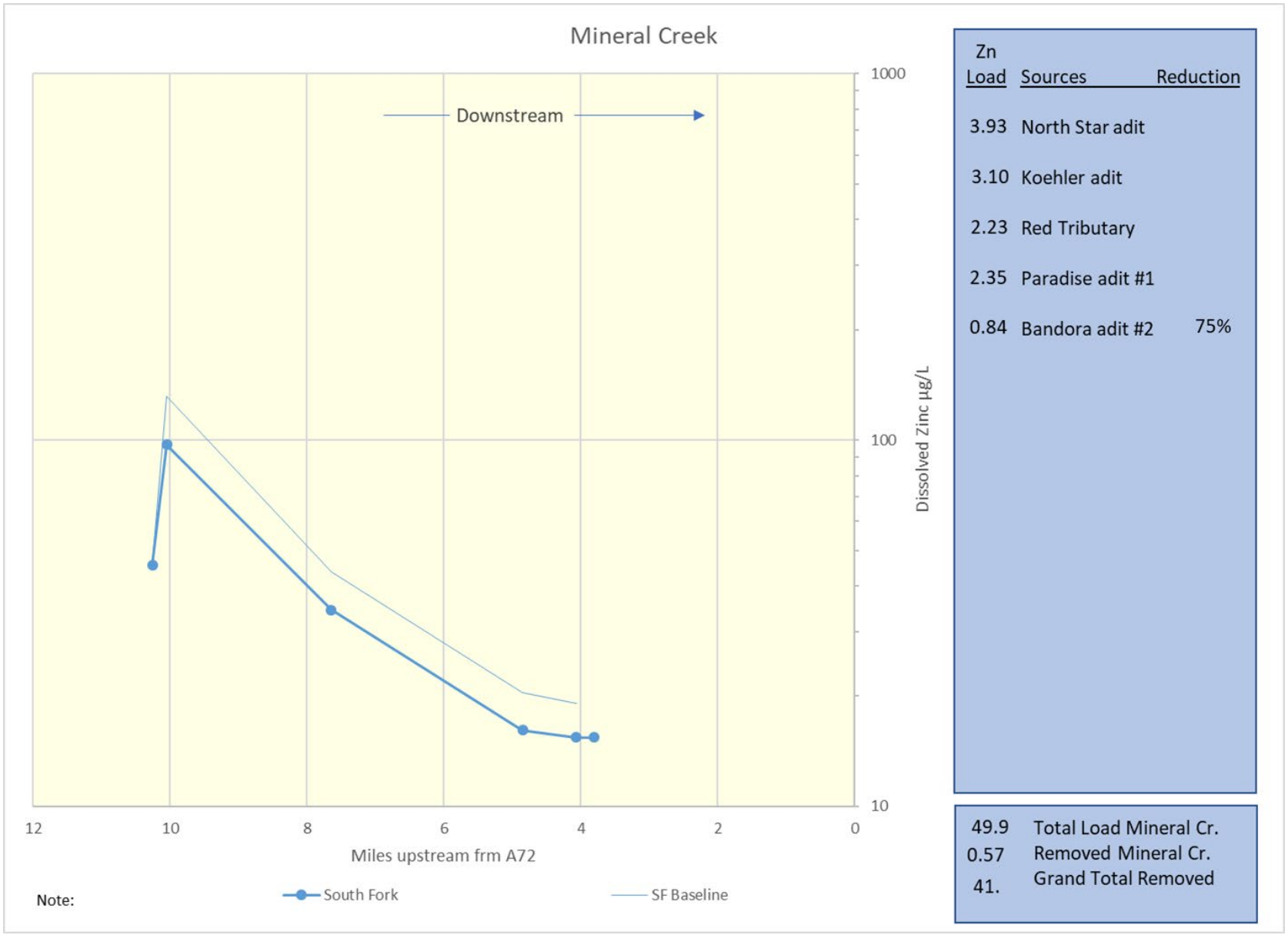

2017 LOW FLOW- CADMIUM
micrograms per liter
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
M23
M25
M26B
M26D
M28
M29A
M29
M32
M33
M34
M38
Total Recoverable
Dissolved
Cd Chronic WQ Standard (Dissolved)


2016 LOW FLOW- ALUMINUM
micrograms per liter
3500
3000
2500
2000
1500
1000
500
0
M23
M25
M26B
M26D
M28
M29A
M29
M32
M33
M34
M38
Total Recoverable
Dissolved
Al Chronic WQ Standard (Trec)


2017 LOW FLOW- ALUMINUM
micrograms per liter
3500
3000
2500
2000
1500
1000
500
0
M23
M25
M26B
M26D
M28
M29A
M29
M32
M33
M34
M38
Total Recoverable
Dissolved
Al Chronic WQ Standard (Trec)


2016 LOW FLOW- ZINC
micrograms per liter
250
200
150
100
50
0
M23
M25
M26B
M26D
M28
M29A
M29
M32
M33
M34
M38
Total Recoverable
Dissolved
Zn Chronic WQ Standard (Dissolved)


2017 LOW FLOW- ZINC
micrograms per liter
250
200
150
100
50
0
M23
M25
M26B
M26D
M28
M29A
M29
M32
M33
M34
M38
Total Recoverable
Dissolved
Zn Chronic WQ Standard (Dissolved)



Zn Load	Sources	Reduction
3.93	North Star adit	
3.10	Koehler adit	
2.23	Red Tributary	
2.35	Paradise adit #1	
0.84	Bandora adit #2	75%

49.9	Total Load Mineral Cr.
0.57	Removed Mineral Cr.
41.	Grand Total Removed

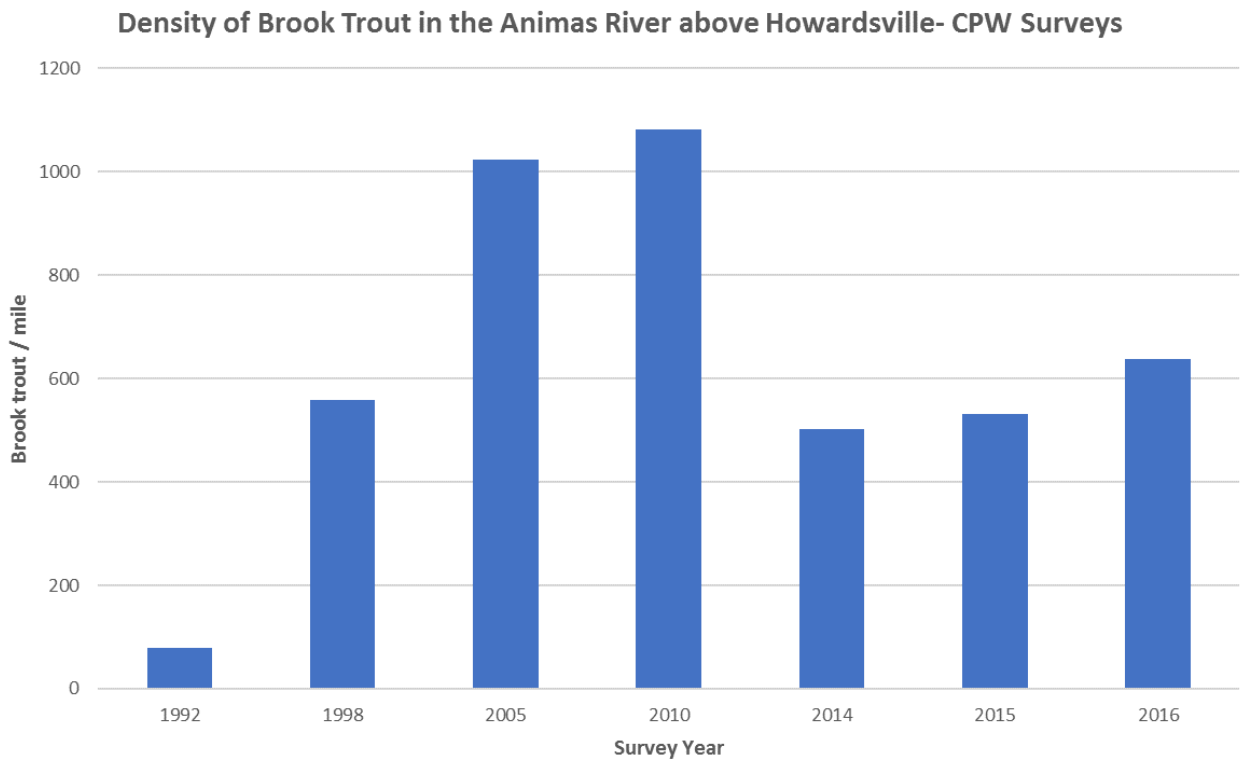
Priority 3-Upper Mineral Creek (Cont.)

Goal-Improve Water Quality

- Data Gaps
  1. High Variability in Bandora Loading Estimates.
  2. Increase Resolution of Risk Evaluation.
  3. Upstream sources?
  4. Current Status of Fishery

- Background Needs
  1. Upstream sources?

Community Surveys (Fish)



Population of brook trout has remained stable over the last several decades

Priority 2-Howardsville Area (Cont.)

Goal-Improve Water Quality

- Risk (Minnie Gulch to A68; ~6.2 miles)
  1. BMI impairment variable; MMI: 54 at A45 (not impaired) and 44.7 at A56 (impaired)
  2. RBT and BRK present and historically present (EU 9), historically present but not surveyed (EU 7) and not historically present and not surveyed (EU 10). Cutthroat trout in tributaries to this reach (Maggie Gulch and Cunningham)
  3. Some sediment toxicity (40-70% survival), no acute SW toxicity
  4. SW Risk Drivers: *EU 7*: Low risk (Zn, Cd). *EU 9*: Low risk (pH, Cu, Al, Cd) Mod. risk (Zn). *EU 10*: Low risk (Cu, Al) Mod. risk (Zn, Cd), *Arrastra down*: Low risk (Cu, Mn), Mod. Risk (Zn, Cd), High risk (Al).
  5. Sediment Risk Drivers: Al, Cd, Cu, Mn, Pb and Zn depending on location.
  6. Habitat evaluated at A45 (good); temperatures suitable for multiple trout species

Priority 2-Howardsville Area (Cont.)

Goal-Improve Water Quality

- Current WQ Standards
  1. Segment 3a; Mainstem of the Animas from Minnie Gulch to Cement Creek; *Agriculture, Aq. Life Cold 1, Recreation E.*
  2. TVS + Seasonal Mod for Cd, Mn, Zn and SSE for Cd.
     - Commission recognized the many unknowns and uncertainties in analysis of source loadings in 3a.
     - Encouraged the continuation of characterization efforts to determine unknown sources of loading
  3. Aquatic Life Indicator Goal
     - Brook Trout: TMDL Target- “Enhancement of existing brook trout fishery”

Priority 2-Howardsville Area

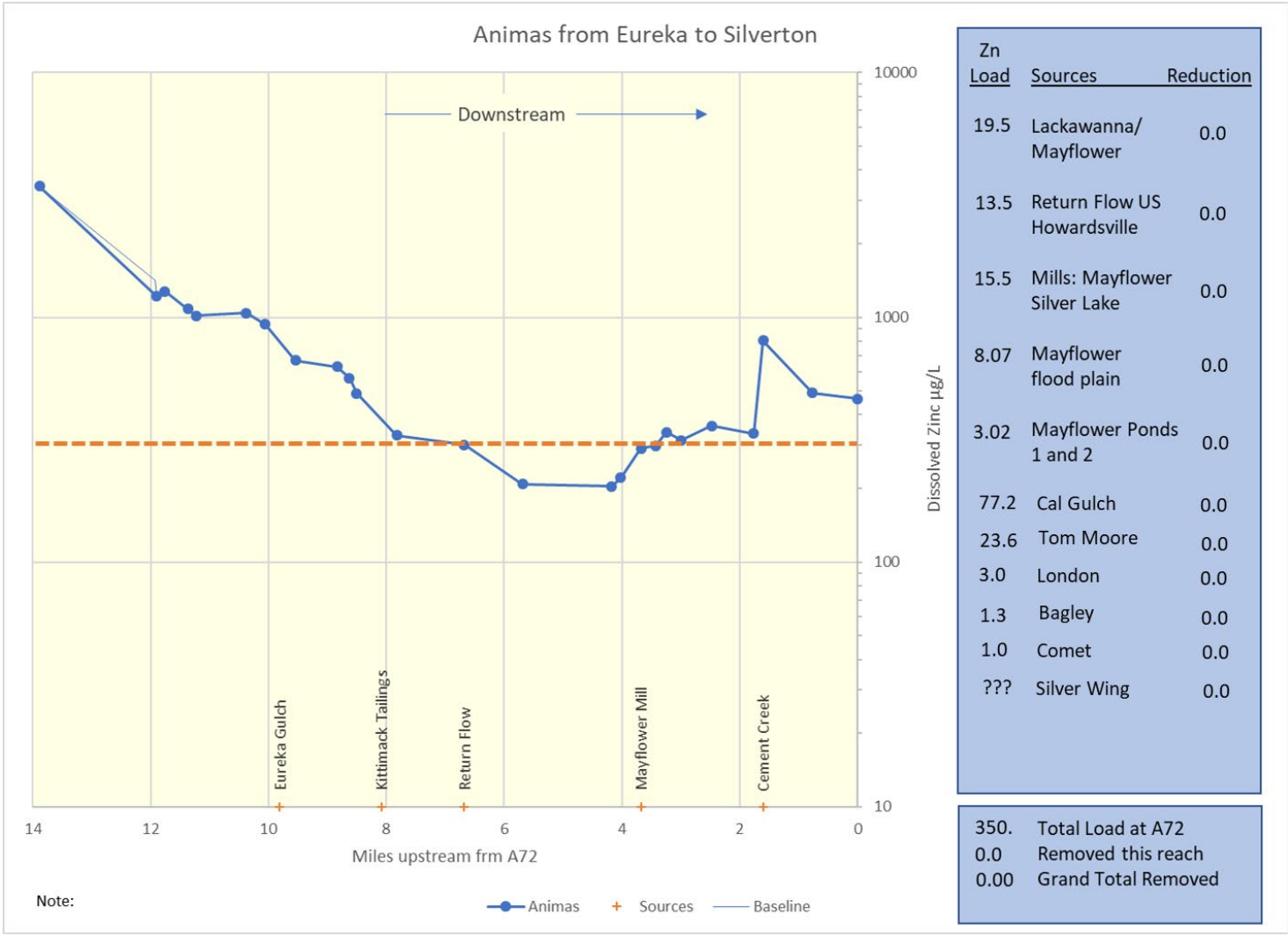
Goal-Improve Water Quality

- Source Areas
  1. California Gulch (77 lbs Zn /day)
     - Columbus Mine (Adit Load ~0.5 lbs Zn/day , Reach loads 20 lbs Zn /day)
     - Frisco/Bagley (Reach loads ~6 lbs/day)
     - Vermillion?
  2. Mainstem Animas
     - Silver Wing (Reach Load 11 lbs/day)
     - Tom Moore (Reach Load 23.6 lbs/day)
  3. Pride of the West Mill (Reach Load ~10 lbs/day)
  4. Mayflower (45-66 lbs/day)

Priority 2-Howardsville Area

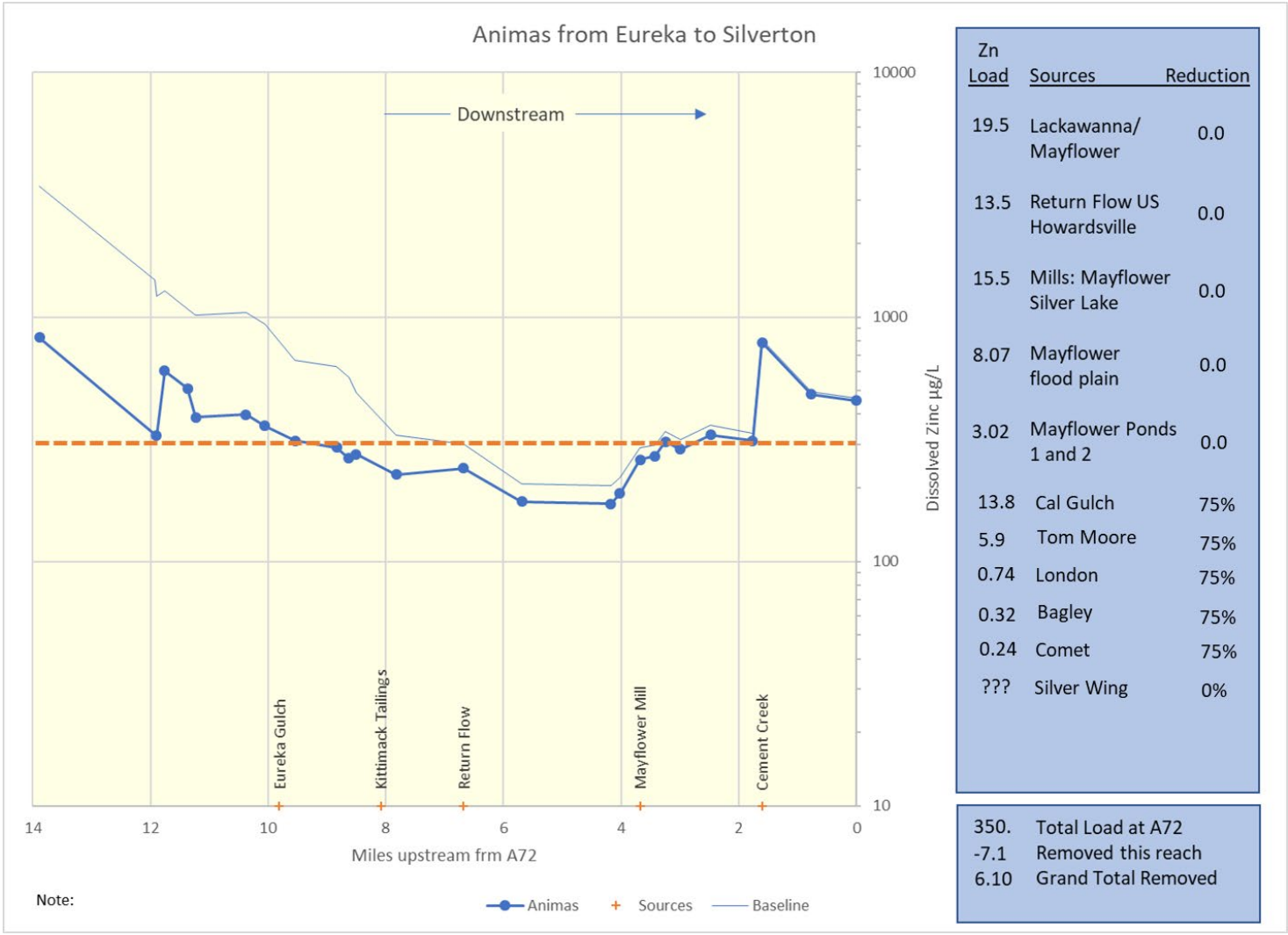
Loading Reduction Scenarios

- Loading Tool
  1. Loading tool can be used to estimate what conditions might be like if various sources are addressed / removed
  2. In the Animas, there are sources above and below where we currently have a robust brook trout fishery at A45
  3. Addressing sources below A45 (e.g. Mayflower) would benefit the Animas down to Cement
  4. Addressing sources above A45 could improve conditions above, through, and below A45
  5. Current version of loading tool likely underestimates the benefit of loading reductions high in the watershed



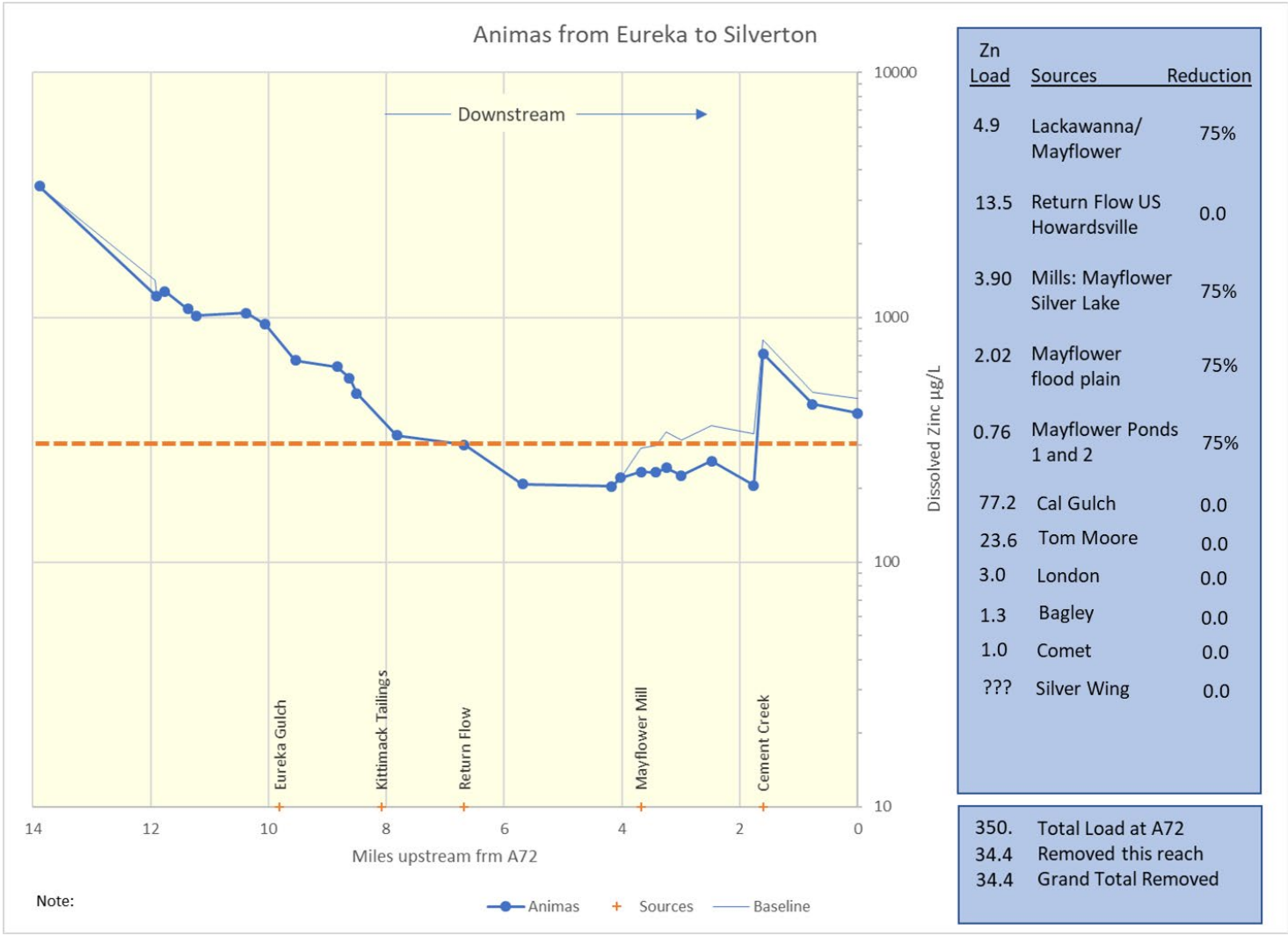
Zn Load	Sources	Reduction
19.5	Lackawanna/ Mayflower	0.0
13.5	Return Flow US Howardsville	0.0
15.5	Mills: Mayflower Silver Lake	0.0
8.07	Mayflower flood plain	0.0
3.02	Mayflower Ponds 1 and 2	0.0
77.2	Cal Gulch	0.0
23.6	Tom Moore	0.0
3.0	London	0.0
1.3	Bagley	0.0
1.0	Comet	0.0
???	Silver Wing	0.0

350.	Total Load at A72
0.0	Removed this reach
0.00	Grand Total Removed



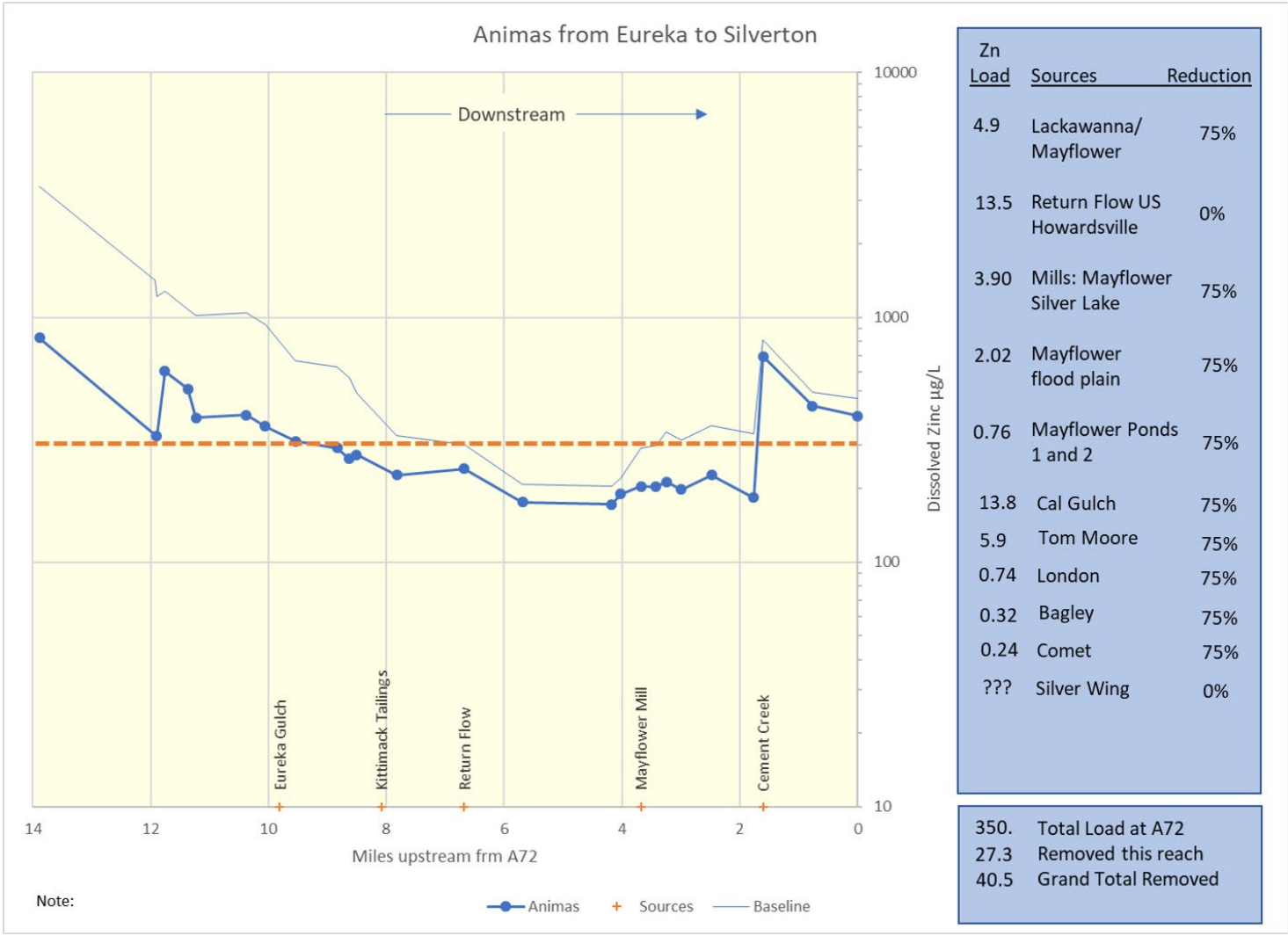
Zn Load	Sources	Reduction
19.5	Lackawanna/ Mayflower	0.0
13.5	Return Flow US Howardsville	0.0
15.5	Mills: Mayflower Silver Lake	0.0
8.07	Mayflower flood plain	0.0
3.02	Mayflower Ponds 1 and 2	0.0
13.8	Cal Gulch	75%
5.9	Tom Moore	75%
0.74	London	75%
0.32	Bagley	75%
0.24	Comet	75%
???	Silver Wing	0%

350.	Total Load at A72
-7.1	Removed this reach
6.10	Grand Total Removed



Zn Load	Sources	Reduction
4.9	Lackawanna/ Mayflower	75%
13.5	Return Flow US Howardsville	0.0
3.90	Mills: Mayflower Silver Lake	75%
2.02	Mayflower flood plain	75%
0.76	Mayflower Ponds 1 and 2	75%
77.2	Cal Gulch	0.0
23.6	Tom Moore	0.0
3.0	London	0.0
1.3	Bagley	0.0
1.0	Comet	0.0
???	Silver Wing	0.0

350.	Total Load at A72
34.4	Removed this reach
34.4	Grand Total Removed



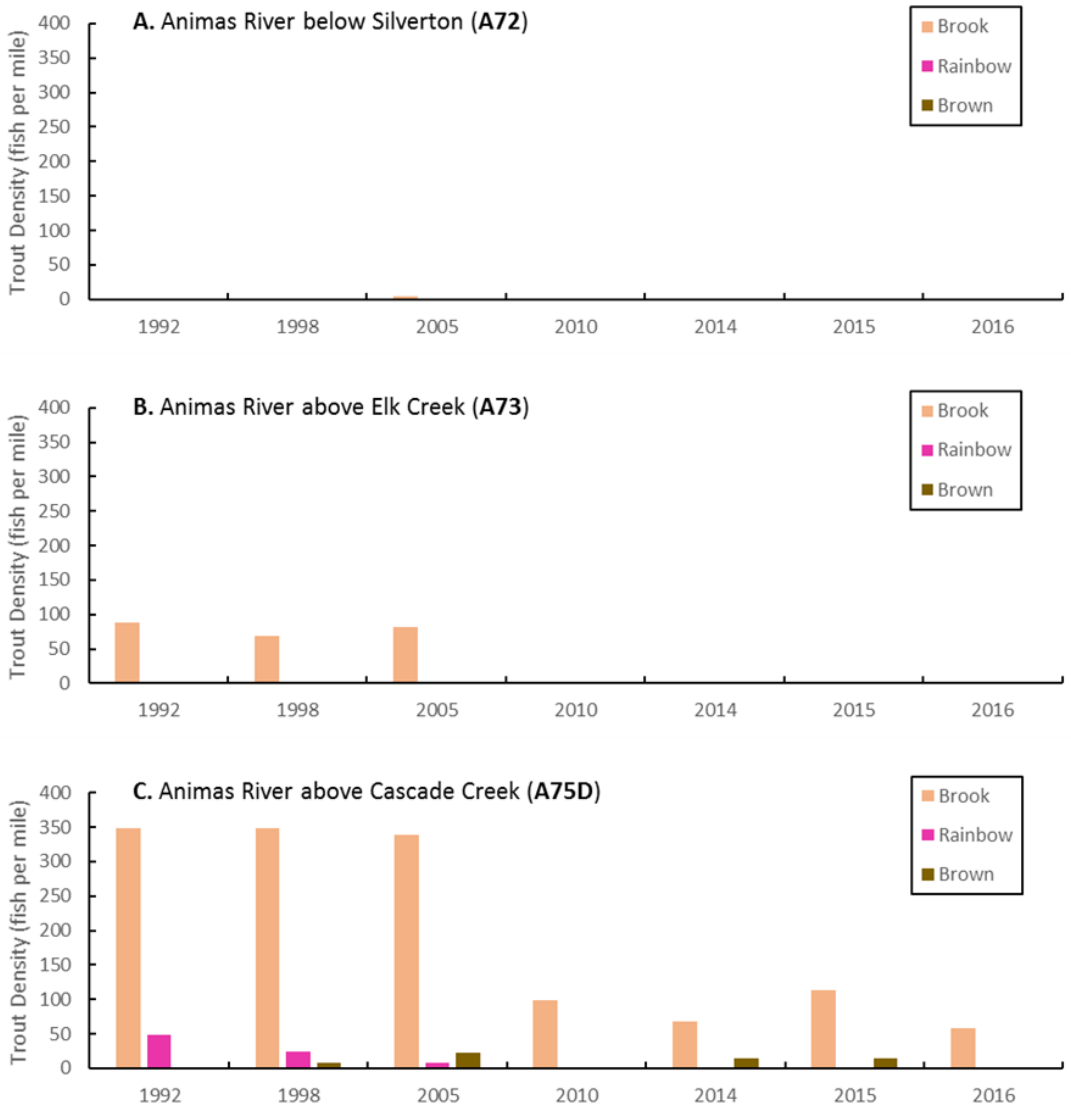
Zn Load	Sources	Reduction
4.9	Lackawanna/ Mayflower	75%
13.5	Return Flow US Howardsville	0%
3.90	Mills: Mayflower Silver Lake	75%
2.02	Mayflower flood plain	75%
0.76	Mayflower Ponds 1 and 2	75%
13.8	Cal Gulch	75%
5.9	Tom Moore	75%
0.74	London	75%
0.32	Bagley	75%
0.24	Comet	75%
???	Silver Wing	0%

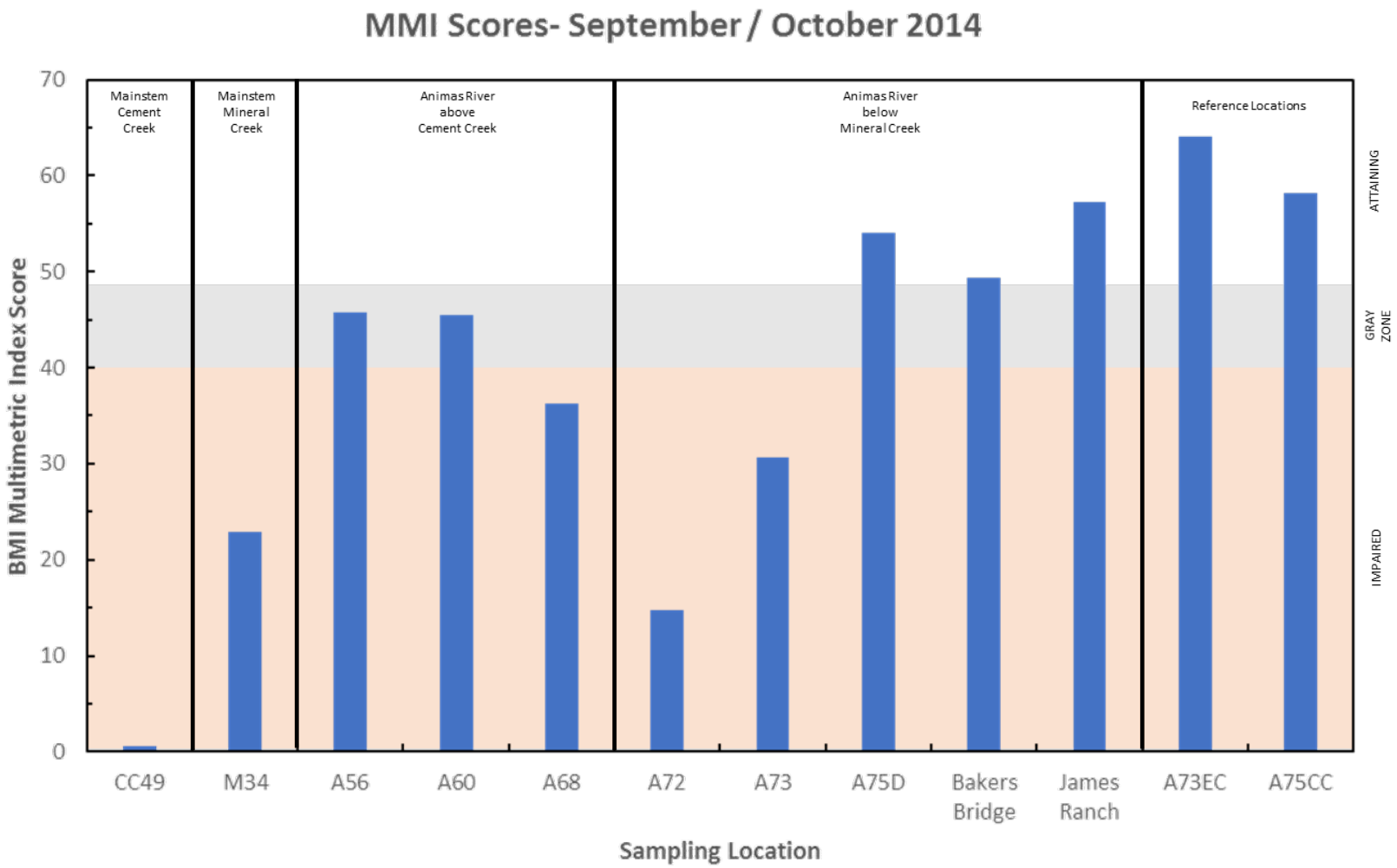
350.	Total Load at A72
27.3	Removed this reach
40.5	Grand Total Removed

Priority 2-Howardsville Area (Cont.)

Goal-Improve Water Quality

- Data Gaps
  1. Reach Loads Don't Match Mine Loads (Bagley, Columbus, Vermillion)
  2. Silver Wing (Limited Adit Data)
  3. Tom Moore (Limited Data)
  4. Pride of the West Mill (Limited Data, Still Draining?, Confirm Loading)
  5. Mayflower
  6. South Fork Eureka
- Background Needs
  1. Confirm Reach Loads in California Gulch are Anthropogenic
  2. Confirm Vermillion is Not Loading


A. Animas River below Silverton (A72)
B. Animas River above Elk Creek (A73)
C. Animas River above Cascade Creek (A75D)
Trout Density (fish per mile)
400
350
300
250
200
150
100
50
0
1992
1998
2005
2010
2014
2015
2016
Brook
Rainbow
Brown


MMI Scores- September / October 2014
BMI Multimetric Index Score
70
60
50
40
30
20
10
0
Mainstem Cement Creek
Mainstem Mineral Creek
Animas River above Cement Creek
Animas River below Mineral Creek
Reference Locations
ATTAINING
GRAY ZONE
IMPAIRED
CC49
M34
A56
A60
A68
A72
A73
A75D
Bakers Bridge
James Ranch
A73EC
A75CC
Sampling Location

Priority 1-Canyon Reach(Cont.)

Goal-Meet TVS (except Al?) in Animas above Elk Creek

- Current WQ Standards
  1. Segment 4a; Animas from Mineral Creek to above Deer Park Creek; *Agriculture, Aq Life Cold 2, Recreation E*.
     - TVS + Seasonal Mod for Al, Fe, pH and Zn and SSE for Cd.
     - Aquatic Life Indicator Goal; Brook Trout
  2. Segment 4b; Deer Park Creek to Bakers Bridge; *Agriculture, Aq Life Cold 1, Recreation E, Water Supply*
     - TVS + temp mod for Arsenic expires 2021.
  3. Chemistry data is limited through the canyon due to remoteness

Priority 1-Canyon Reach (cont.)

Goal-Meet TVS (except Al?) in Animas above Elk Creek

- Source Areas
  1. All upstream priority source areas
  2. Cement Creek
     - Red and Bonita (65 lbs/day)
     - Mogul (21.4 lbs/day)
     - Natalie Occ. (10.23 lbs/day)
     - Grand Mogul (7.12 lbs/day)
     - Prospect Gulch (3.07 lbs/day)
     - Other
- Data Gaps
  1. Limited data in Canyon reach
  2. Mine Pool

Priority 1-Canyon Reach (cont.)

Goal-Meet TVS (except Al?) in Animas above Elk Creek

- Background Needs
  1. Mine Pool?
  2. Same considerations for other priority areas.

I. Improve Water Quality and Aquatic Life below Silverton at Least to Conditions Documented in 1999-2003

During the early 2000's, water quality in the Animas River below Silverton was arguably the best it had been in a hundred years. Water quality, macroinvertebrate and fish data from that time period all demonstrate that conditions in the Animas River between Silverton and Bakers Bridge can be much better than they are today.

In the early 2000's, a water treatment plant in Gladstone treated the drainage coming out of the American Tunnel (AT) and all of Cement Creek upstream of the AT during low-flow time periods. Essentially, it treated the "big four" discharging mines (AT, Red & Bonita, Gold King, and Mogul), the Grand Mogul, and several other small discharging mines and mine waste piles.[2] In addition, by the early 2000's, a number of other mine remediation projects had been completed in the Animas River basin.

Related Goals and Action Items:

1. Monitor aquatic life (macroinvertebrates and fish) as well as water quality.

2. Improve water quality in other areas above Silverton that potentially could support aquatic life. These include the Animas River above Cement Creek up to at least Minnie Gulch, South Mineral Creek, and Mineral Creek above Burro Bridge.

3. Reduce risk of releases of impounded mine water and of collapses of mine waste piles.

4. Set clean up goals that account for natural metal loading.

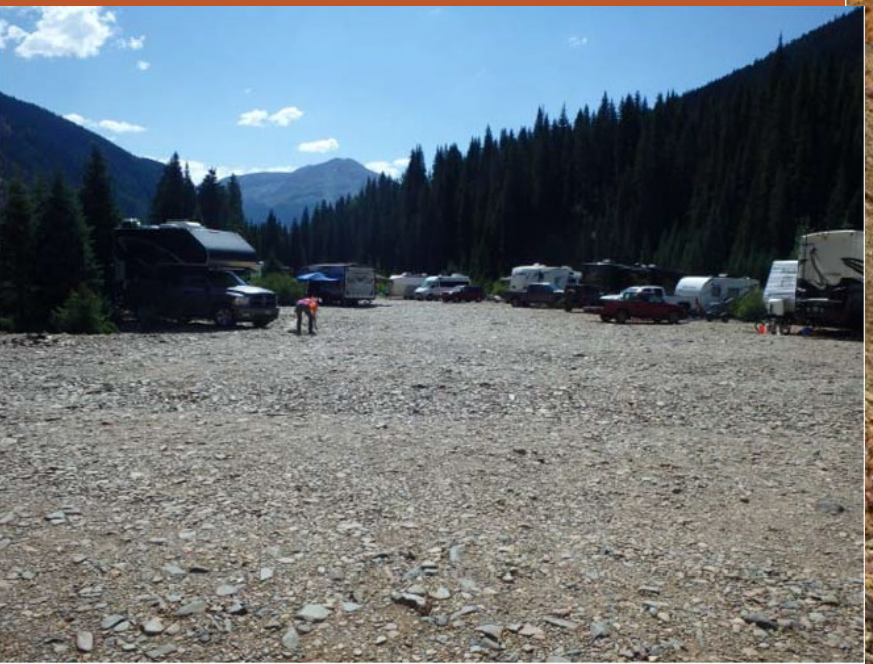
5. Develop water quality goals that are protective of human health and environment.

Stabilize Mine Source Areas

Minimize recreational exposures

Reduce erosion into waterbodies

Reduce unacceptable terrestrial risks



Minimize Unplanned Releases

Focus on Fluid Hazard

Inputs to the Decision

Risk Assessments – define unacceptable human and environmental risk *(Human Health 95%, Aquatic 85%, Terrestrial 20% complete)*

Habitat assessment – Determine physical limitations to potential aquatic life improvements in Animas River headwaters *(95% complete)*

Loading evaluation – assist with cost/benefit analysis and prioritized remediation for water quality improvements *(75% complete)*

Background contribution – limit scope of cleanup to what results in achievable improvements in water quality and within CERCLA authority *(15% complete)*

Ground water investigations – interconnectedness of mine workings and ground water transport will inform impacts to surface water and what actions may be most beneficial and cost effective, Including measures to mitigate unplanned releases such as flow control structures and bulkheads *(10% complete)*

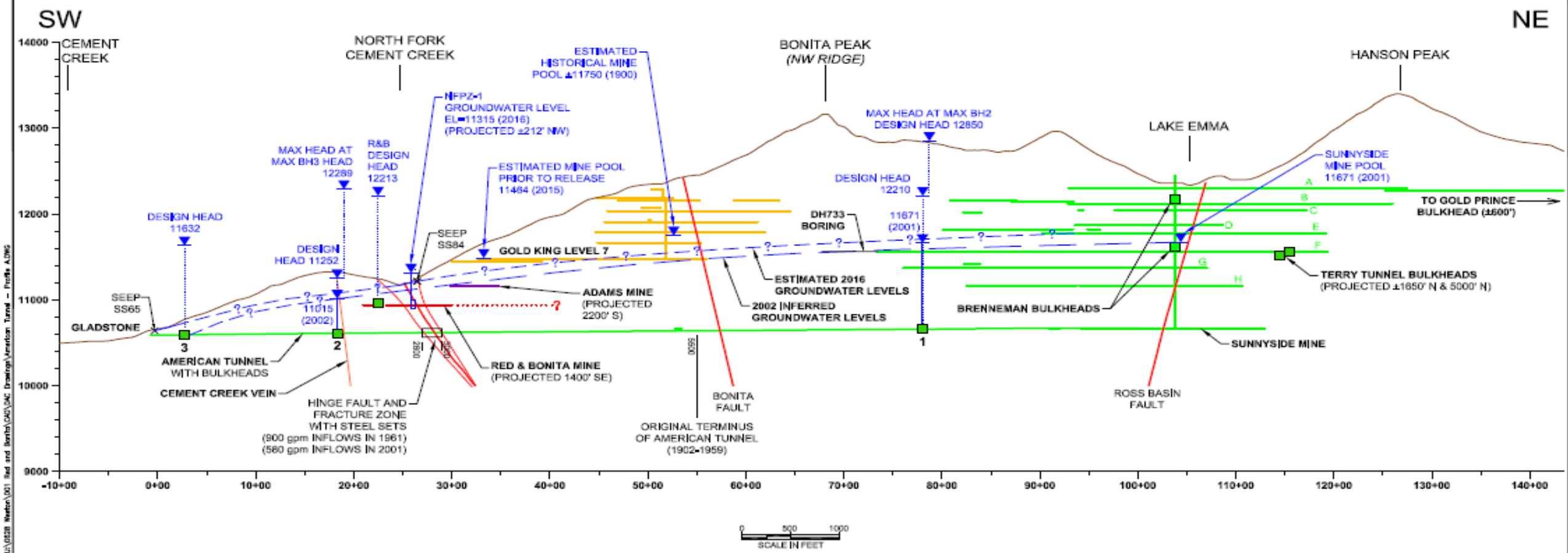
Setting Site-wide Goals

- Most inputs (except groundwater and background) complete by 2019.
- Groundwater investigation is dependent on UAO schedule.
- Background schedule depends on relevance to decision making.
- Investigation data will be used to revise goals as appropriate.


Photo Credit Andrew Todd

Estimating Background

- Upstream/downstream
- Comparison to unimpacted groundwater
- Treat known sources
- Geology based
- Selectively treat below background



NOTES:

1. MINES FROM 3D CAD MODEL USING CDRMS GIS DATA.
2. PROFILE A IS ALONG THE AMERICAN TUNNEL APPROXIMATELY PARALLEL TO THE GOLD KING AND DAVIS VEINS.
3. 1900 ESTIMATED SUNNYSIDE MINE POOL FROM MARKS, 1917.
4. EXISTING GROUND SURFACE FROM USGS DIGITAL ELEVATION MODEL.

JOB NO. 0626.002.01

BONITA PEAK MINING DISTRICT

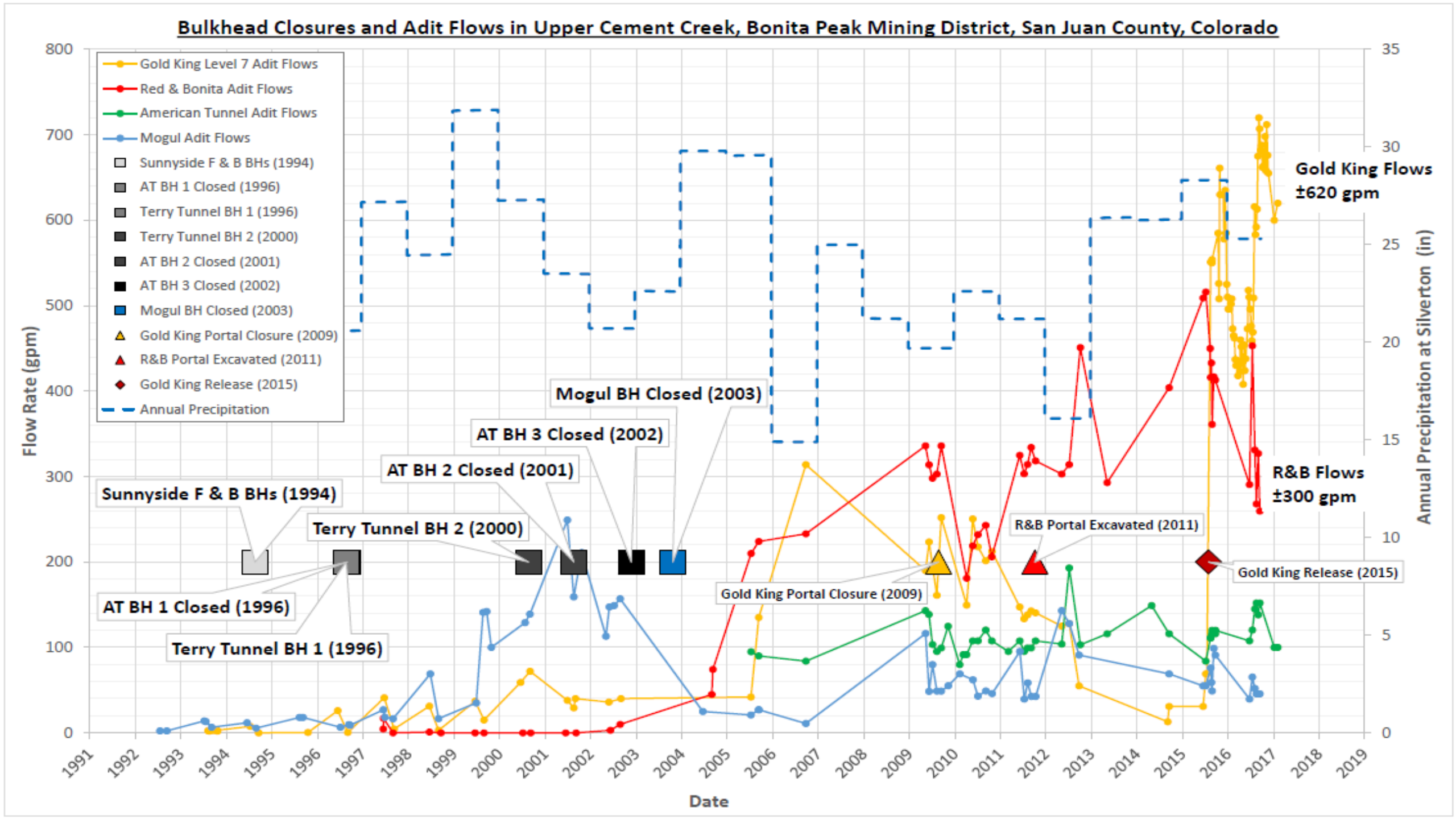
American Tunnel Profile A

DEERE & AULT CONSULTANTS, INC.

FIGURE NO. **2**

DATE: **APRIL 2017**

SCALE: **AS NOTED**


Bulkhead Closures and Adit Flows in Upper Cement Creek, Bonita Peak Mining District, San Juan County, Colorado
Gold King Level 7 Adit Flows
Red & Bonita Adit Flows
American Tunnel Adit Flows
Mogul Adit Flows
Sunnyside F & B BHs (1994)
AT BH 1 Closed (1996)
Terry Tunnel BH 1 (1996)
Terry Tunnel BH 2 (2000)
AT BH 2 Closed (2001)
AT BH 3 Closed (2002)
Mogul BH Closed (2003)
Gold King Portal Closure (2009)
R&B Portal Excavated (2011)
Gold King Release (2015)
Annual Precipitation
Flow Rate (gpm)
Annual Precipitation at Silverton (in)
Date
Gold King Flows ±620 gpm
R&B Flows ±300 gpm
Mogul BH Closed (2003)
AT BH 3 Closed (2002)
AT BH 2 Closed (2001)
Sunnyside F & B BHs (1994)
Terry Tunnel BH 2 (2000)
AT BH 1 Closed (1996)
Terry Tunnel BH 1 (1996)
Gold King Portal Closure (2009)
R&B Portal Excavated (2011)
Gold King Release (2015)

Segment 9

Acute Standards

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Al(Trec)	4680	4950	4560	3800	1390	1350	1290	2040	2570	2680	3450	4050

Chronic Standards

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
pH	4.9-9.0	4.8-9.0	4.9-9.0	5.9-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0	6.2-9.0	5.4-9.0
Al(Trec)	4680	4950	4560	3800	1390	1350	1290	2040	2570	2680	3450	4050
Cu	TVS	TVS	TVS	18	20	TVS	TVS	TVS	TVS	TVS	TVS	TVS
Fe	3420	3800	4370	3370	3150	2210	2275	2280	3020	3580	3620	3490
Zn	TVS	TVS	TVS	TVS	230	TVS	TVS	TVS	TVS	TVS	TVS	TVS